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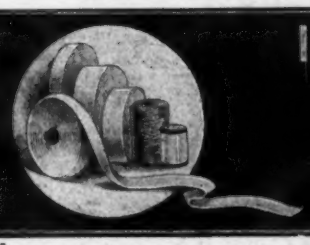

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ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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SINGLE-PHASE COMMUTATOR MOTORS.

CONGRATULATIONS are due to Dr. Stanley Parker Smith not only on the success of his lecture before the Institution of Electrical Engineers (it *was* a lecture; he did not read the paper), but also on the courage with which he enumerated the faults to which the a.c. commutator motor was liable, and of which it might be thought, as Beatrice said of Benedick's "bad parts," that they "maintained so politic a state of evil, that they will not admit any good part to intermingle with them." But we are careful to use the word "liable" and not "subject"; for, as Dr. Smith showed, in spite of its potential drawbacks, this motor can be designed and built to operate quite satisfactorily, and it possesses certain advantages which are not shared by its d.c. rival. We were especially pleased that the lecturer gave full credit to Mr. Llewelyn Atkinson for his pioneer work in the invention of single-phase motors of this class, which, as we have previously pointed out, is apt to be overlooked, owing to its sepulture in the private *Minutes* of Proceedings of the Institution of Civil Engineers. Due credit was also given to Mr. Alexander Siemens, and to Professor Ernest Wilson for his invention of the polyphase commutator motor as long ago as 1888. It is pleasing to know that British genius led the way, though it was left mainly to foreign engineers to follow the path thus indicated.

There is at present but a limited demand for a.c. commutator motors for industrial purposes; the induction motor is much cheaper, simpler, and more robust than any machine with a commutator can possibly be, and it fulfils sufficiently well the bulk of the requirements ordinarily met with. But there are considerations which should not be overlooked, namely, that the use of alternating current is rapidly increasing, and that for certain applications the a.c. commutator motor is peculiarly well adapted. By far the most important of the latter is electric traction on main-line railways.

When the Lacour or Winter-Eichberg single-phase motor was developed to the stage of commercial utility, Mr. (now Sir) Philip Dawson promptly pounced upon it, and pointed out that it afforded a practicable solution of the railway electrification problem, a theory which he shortly afterwards successfully translated into practice on the London, Brighton & South Coast Railway Co.'s suburban lines. But the Advisory Committee of the Ministry of Transport has decided that the high-pressure direct-current system is better adapted to the conditions obtaining in this country. Whilst we do not quarrel with that verdict, which no doubt was in some measure due to the weight of American practice, we must again point out that our engineering interests are world-wide, and that Continental practice generally favours the use of alternating current, which is being and will be adopted on an enormous scale in certain areas. The future course of events in countries where great railways will be needed for the development of the interior, such as China, South America, and Africa, must also be kept in view. Wherever water-power is available at a reasonable distance—which may be 100 miles or more—and in adequate quantity, these railways will probably be operated by electricity, and if we are to secure our rightful share in the work of construction, we must be prepared to carry it out with alternating current if that is called for by the engineers in control of such projects.

Let us not be unduly influenced by the undoubted success of the Chicago-St. Paul Railway, where the conditions were in many respects unique; neither let us stake too much on the prospects of the development of the mercury-vapour rectifier or the thermionic valve for the conversion of alternating to direct current on the grand scale. This country taught the world how to build railways, and has always been in the front rank in railway construction, which will be one of the most important branches of engineering for many years to come; it behoves us, in justice to ourselves, to keep ourselves *au fait* with every efficient means of equipping and operating electric railways, and to be prepared to lay down a.c. as well as d.c. systems whenever the opportunity presents itself. Dr. Smith gave the most candid expression to his views regarding our attainments in respect of d.c. commutator motors; we fear that he was fully justified, and we hope that our manufacturers will take steps to strengthen this weak point in our technical equipment.

The French Electrical Industry.

Some information concerning the situation of the French electricity industry at the close of 1921 has been published by *L'Information*, of Paris. After giving a list of the highest and lowest quotations for the shares of different companies in 1920 and 1921, the newspaper states that the business of the supply companies in general has not yet benefited from the radical change in the conditions of working which took place in 1921. The years of war were very prejudicial to their interests either as a result of the scarcity of labour and the high prices for coal or, in the North of France, as a consequence of the systematic destruction by the Germans and the removal of the plant and machinery. On the one hand the tariffs have been revised and the price of coal has fallen, while the undertakings which suffered from the occupation have actively pushed forward the restoration of the works which were still standing, the recovery of plant, renewal of equipment, and the erection of new stations. Thus the companies are now not only in a situation equal to that of 1913, but are also confronted with increased possibilities. In fact, most of the manufacturers and companies in the North have abandoned the idea of producing on their own account in favour of procuring supplies from the central stations. In addition, the collieries in the North are again beginning to produce the normal quantities, and thus the deliveries of coal are assured.

The operations of the hydro-electric works in 1921 were less satisfactory from an industrial point of view, because the extreme drought which prevailed during the whole of the year exhausted the rivers utilised, and many companies were compelled to have recourse to steam generating plant, which involved them in additional expenses. Concerning the manufacturing companies, our contemporary remarks that their activity was greatly hampered by the scarcity of orders resulting from the general crisis. Lately, however, a revival of orders has been noticed. The leading railway companies are undertaking the progressive electrification of their systems, the Telephone Administration is on the point of improving its lines, wireless telegraphy is extending, &c. On the whole it may be claimed that the critical period is over and a general improvement is foreseen.

Co-operative Advertising in the Electrical Industry.

As readers of the Electrical Review will have noticed, the question of co-operative advertising in the industry is one that has been ventilated frequently of late, and, having heard so many views expressed by representatives of all branches of the industry, we cannot help feeling that this demand for co-operation comes not a moment too soon. There is no doubt that it is time a really intensive effort was made to bring to the notice of the public the advantages which accrue to users of electricity as compared with the users of other mediums for lighting, heating, and power. It will be remembered that at both the Salesmanship Lectures which have so far been held by the Electrical Development Association, attention has been directed to this matter, and it is pleasing to note that it was also the subject of discussion at an informal meeting of the Institution of Electrical Engineers on Monday last, when it was introduced by Mr. J. W. Beauchamp, the Director and Secretary of the E.D.A. We all know the objects of the E.D.A., one of the chief factors in connection with the formation of which was the preliminary work done by the Electrical Development Committee of the I.M.E.A., a Committee which was largely concerned with the question of co-operative advertising. Possibly, through the broadening scope of the E.D.A., the question of co-operative advertising has not received quite the amount of attention it might have done, although Mr. Beauchamp and his staff have worked hard in this direction, and have distributed large quantities of publicity matter. At any rate, it might be said that this is the first time that the problem has been discussed at anything like a representative meeting of the industry, and it is a sign of the times that the industry as a whole now seems to be taking a more active interest in it.

It is in connection with daily paper advertising, however, that there seems to be the greatest scope for co-operation. Most of the advertising done at present in this manner is by the manufacturers of apparatus, which is, perhaps, only natural. A number of large advertisements have been placed by the E.D.A. from time to time in daily papers. These have consisted of displayed advertisements, incorporating the various articles which manufacturers have to sell, and in the centre a short article, prepared by the E.D.A., pointing out the value of electrical apparatus generally. It was recently stated by an eminent industrialist that the public are more susceptible to the appeal of articles embodying good, common-sense arguments than of displayed advertisements, but that, perhaps, is dependent upon the class of buyer it is desired to reach. It is questionable, however, whether the public will have time to read many advertisements served up in that manner, however artistic they may be from a literary point of view. What must be aimed at is simplicity, and it must be remembered that not only have the public to be told that advantages will accrue from the use of electricity, but they have to be educated in order that they may appreciate those advantages to the full.

British Interest in Argentina.

It is natural that any sign of revival in a market like that of Argentina should be eagerly sought and welcomed by the British exporter. The vast wealth of the Republic in the raw produce which is needed by an industrial nation, combined with the fact that Argentina's own manufactures are but little developed, has in past years made the Republic an attractive outlet for British goods. Some degree of confidence in the prospects of an early recovery in trade has therefore been imparted by the reports that Argentine produce is moving more freely into consumption and that the accumulated stocks of imported merchandise are being gradually absorbed Faith in the country has, however, been shaken by the situation which has arisen with regard to the British capital invested in its railways. It is not surprising that the interest of the capitalist should wane when obstacles are placed in his way which prevent an adequate return on and protection of the funds that he has provided. Fortunately news has now been received which leads one to hope that the Argentine Government has taken a reasonable view of the just demand of the railway companies for permission to charge rates sufficiently high to yield a fair profit. As is indicated by the Commercial Secretary at Buenos Aires, Mr. Chalkley, whose report is summarised in another column, if Argentine enterprises offer inducements corresponding to the changed conditions brought about by the war, instead of the meagre return they yield at present, it will be found that the United Kingdom is again the most willing as well as the most liberal source from which to obtain capital.

THE DIELECTRIC STRENGTH OF SOLID INSULATING MATERIALS.

By W. S. FLIGHT, A.M.I.E.E., M.A.I.E.E.

SYNOPSIS.

THE dielectric strength of insulating materials is the foundation of all insulation design. It is not usually realised how many factors influence the dielectric strength. The most important of these factors are discussed, and test results are given to enable the magnitude of the variations produced to be more fully appreciated. As no country has as yet any recognised standard set of rules for conducting the dielectric strength test, it is desirable that this matter should receive attention by all those who have had practical experience in testing insulating materials. Recommendations are made based on the author's own observations.

INTRODUCTION.

Although there are certain objections to the use of the term "dielectric strength," it has now become the recognised method of expressing the insulating value of materials. By dielectric strength is meant the voltage required to breakdown unit thickness of any material. Throughout this article dielectric strength is expressed as volts per mil (V/M) (1 mil=0.001 inch). In many ways the dielectric strength of insulating materials corresponds to the tensile strength of structural materials, but unlike the latter it is influenced to a very large extent by the methods employed for its determination.

Some of the principal factors which influence the dielectric strength of solid insulating materials are considered below:—

1.—TEST EQUIPMENT.

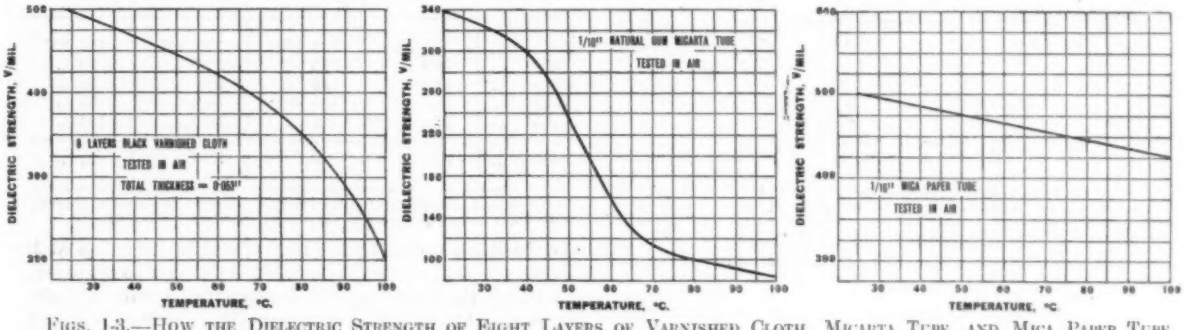
As it is the maximum value of the voltage which breaks down the insulation, a voltmeter reading is only of any value when the wave form is sinusoidal. To prevent any high-frequency oscillations it is necessary that the voltage be regulated without breaking the circuit, and that the natural period of oscillation of the secondary circuit due to the capacity of the sample under test should be at least 40 times the applied frequency. This latter condition is easier to obtain if the leakage reactance of the testing transformer is small.

The high-pressure transformer should be of at least 5 kVA, and should be connected to a separate alternator of not less than 10 kVA and of a normal voltage of not less than one and a half times the l.p. voltage of the testing transformer.

The applied frequency should be about 50; a variation in frequency from 25 to 125 cycles does not introduce any large error, but with a range from 100 to 10,000 cycles there would be a noticeable change in the puncture voltage, the latter then decreasing as the frequency increased.

The voltage should be raised at a uniform rate by means of a motor-driven rheostat, or by means of a hand-operated rheostat adjusted at fixed time intervals, in series with the field of the alternator. The resistance between the steps of the rheostat should be graduated so as to produce approximately the same percentage increase in voltage for each step.

The h.p. voltage is usually measured by a voltmeter connected across the l.p. terminals of the testing transformer and multiplied by the ratio of transformation.



FIGS. 1-3.—HOW THE DIELECTRIC STRENGTH OF EIGHT LAYERS OF VARNISHED CLOTH, MICARTA TUBE, AND MICA PAPER TUBE DECREASED WITH INCREASE IN TEMPERATURE.

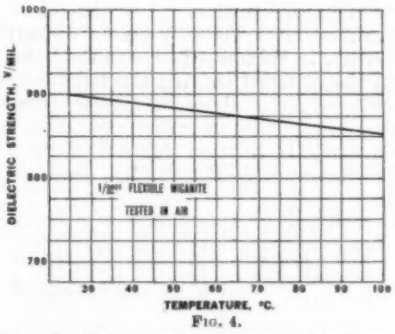


FIG. 4.

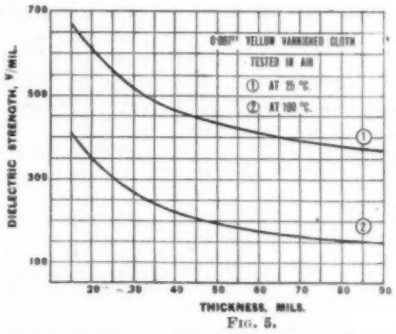


FIG. 5.

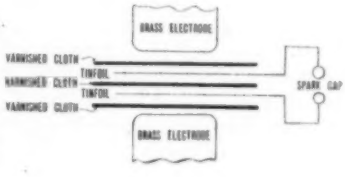


FIG. 6.

FIG. 4.—HOW THE DIELECTRIC STRENGTH OF A PLATE OF FLEXIBLE MICANITE DECREASED WITH INCREASE IN TEMPERATURE.
FIG. 5.—HOW THE DIELECTRIC STRENGTH OF VARNISHED CLOTH DECREASED WITH INCREASE IN THICKNESS.
FIG. 6.—ARRANGEMENT OF TINFOIL AND SPARK GAP DURING TESTS ON VARNISHED CLOTH.

2.—INITIAL TEMPERATURE OF THE INSULATION.

Just as the resistance of all conductors increases with increase in temperature, so the insulation resistance and dielectric strength of all solid dielectrics decrease with increase of temperature. Fig. 1 shows the variation in dielectric strength with temperature in the case of a sample of varnished cloth, whilst fig. 2 illustrates this for a micarta tube. When in service in electrical machinery the insulation is heated by the energy losses in the copper and the iron, and whilst at these high temperatures it has to withstand the voltage stresses. As the standardisation rules permit an observable temperature of 95 deg. C. for Class A insulation, and as the hot spot temperatures in large machines are liable

to be appreciably higher than the maximum observable temperature, it is of the utmost importance that the dielectric strength of insulating materials should be determined at the maximum temperature the materials are liable to be exposed to, even if only for a very short time, in service. Class B insulation is permitted by the rules to be exposed to observable temperatures of 115 deg. C., and in this connection it is interesting to note that the dielectric strength of Class B insulation does not decrease with increase in temperature to anything like the same extent as that of Class A. Examples of this are shown in figs. 3 and 4.

3.—Thickness of Insulation.

If a bar of metal fails under tension with a load of 5,000 lb., a bar of twice the sectional area of the same grade of the same material will fail at approximately

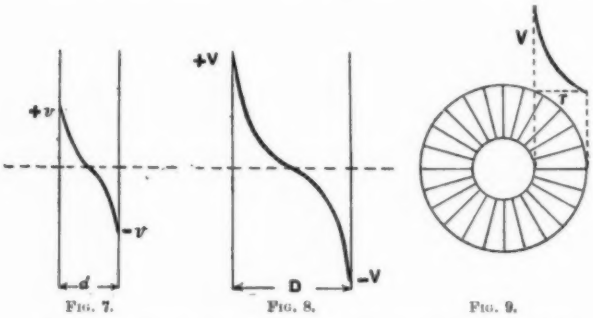


Fig. 7. Fig. 8. Fig. 9.

In fig. 7 the voltage across each layer has been plotted on the vertical line drawn through the centre of the layer, on which it was obtained. Due to the arbitrary choice of the abscissæ, the shapes of the voltage distribution curves are only approximate. They do, however, serve to illustrate the fact that when the stress on the dielectric approaches the breakdown value, the distribution of voltage may be affected by the unequal temperatures of the individual layers of insulation, and the resulting distribution may be very different to that attained when the stress is lower.

Fig. 7.—Probable Distribution of Voltage Gradient between Electrodes when only a Small Distance Apart.

Fig. 8.—Probable Distribution of Voltage Gradient between Electrodes when Separated a Greater Distance.

Fig. 9.—Distribution of Voltage Gradient through Thickness of Insulating Tube.

10,000 lb. In other words, the tensile strength of metals is in general independent of the size of the sample tested. The dielectric strength of insulating materials is, however, very largely influenced by the thickness of the material under test. When mica splittings of thickness about 0.001 in. are tested, it is often found that the dielectric strength is as high as 5,000 volts per mil; a sheet of the same quality of mica having a thickness of 1/32 in. will only have a dielectric strength of about 1,500 volts per mil. Whilst making a plate-glass condenser for h.v. test it was found that although one sheet of the glass had an average breakdown voltage of 25,000 volts, two sheets repeatedly broke down at 42,000 volts, whilst three thicknesses had an average breakdown voltage of 50,000 volts. Fig. 5 shows the decrease in dielectric strength with increase in thickness of varnished cloth when tested at air temperature, and also when tested at 100 deg. C. It was known that in the case of an absorbent material such as cloth, there is always an appreciable leakage current, which heats up the insulation. As the inner layers of cloth cannot get rid of this heat as quickly as the outer layers, they will rise to a higher temperature than the latter, and as they will then have a lower insulation resistance the voltage distribution across each layer cannot be uniform. To ascertain the actual voltage distribution in a certain case, layers of tinfoil were placed between three layers of varnished cloth, and a variable spark gap was connected across the tinfoil as shown in fig. 6. The voltage across the brass electrodes was kept constant, at any desired value, for two minutes, to permit the condition to become steady, and then the gap was reduced until it just sparked over. As the outer layers and electrodes were symmetrical it was assumed that the voltage across them would be half the difference between the total voltage and the voltage across the centre piece. The results

TABLE I.*

Results of Breakdown Voltage Tests on Sheets and Tubes of Bakelite Micarta.

Test.	Plates.		Tubes.	
	1/8 in. thick.	1/4 in. thick.	1/16 in. thick.	1/4 in. thick.
No. 1 ...	65 kV	115 kV	51 kV	103 kV
No. 2 ...	62·5 ,,	125 ,,	57·5 ,,	90 ,,
No. 3 ...	72·5 ,,	129 ,,	50 ,,	90 ,,
No. 4 ...	76 ,,	139 ,,	52·5 ,,	98 ,,
No. 5 ...	77·5 ,,	132 ,,	50 ,,	104 ,,
Average...	70·1 ,,	128 ,,	52·5 ,,	97 ,,

*Taken from an article on the "Properties and Uses of Bakelite Micarta," by R. W. E. Moore, published in the *Electric Journal* for July, 1913.

obtained are shown in fig. 10. It will be seen that at 10 kV the stress is practically uniform on all three layers. At 11 kV there are signs of inequality in voltage distribution. At 12 kV the inequality becomes marked, whilst at 14 kV it becomes very pronounced, and at 15 kV the material broke down after about half a minute. This test confirms the opinion that in the case of such materials as varnished cloth the decrease in dielectric strength with increase in thickness is due to the leakage currents through the material causing the temperature of the inner portions to rise above the temperature of the outer portions, and so cause more stress to fall on the outer layers than would be the case if the temperature, and consequently the voltage distribution, were uniform across the insulation. Thus materials of this nature may fail by the outer layers being first punctured, and not by initial puncture of the inner layers, as has been thought previously.

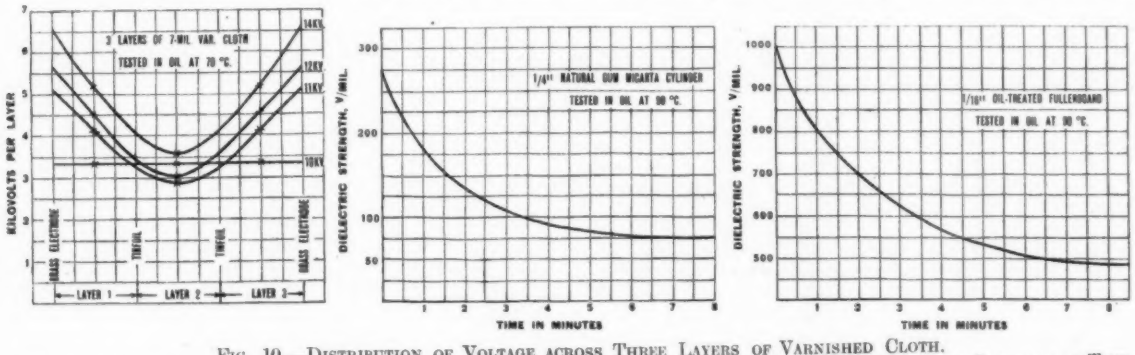


Fig. 10.—Distribution of Voltage across Three Layers of Varnished Cloth.

Figs. 11 & 12.—How the Dielectric Strength of Micarta Cylinder and Fullerboard Decreased with Increase of Time of Application of the Voltage.

With homogeneous non-absorbent materials, such as glass or mica, the leakage currents are too small to account for decrease in the dielectric strength with increase in thickness, and in such cases the explanation is probably to be found in the inequality in the electric field resulting from increasing the distance between the electrodes. For testing flat sheets of insulating materials it is customary to employ flat disk electrodes; the voltage gradient (represented by the slope of the voltage-

distance curve) between the electrodes when only spaced a slight distance apart is probably somewhat as represented in fig. 7. When the distance between the electrodes is increased, as when two, three, or four layers of the material are tested in series, the distribution of the field will be more as shown in fig. 8. In the latter case it will be observed that the stress (as represented by the slope of the voltage curve) on the layers adjacent to the electrodes increases as the distance between the electrodes is increased. As soon as ever the stress on these layers exceeds the dielectric strength of the material, these layers fail, and the whole of the voltage is then thrown on to the inner layers, thereby subjecting them to a stress which will usually exceed their dielectric strength, and thus complete failure will result. The various steps forming the breakdown usually follow one another so rapidly that to the tester it appears to be instantaneous, although in isolated cases the gradual breaking down can be at least partly observed.

4.—Shape of the Insulating Material.

In discussing thickness, it was shown that this influenced the dielectric strength due to the irregularity of the electric field. Any other factor which alters the dielectric field will also affect the dielectric strength. In the case of insulating tubes, cylinders, &c., the lines of dielectric force are radial as shown in fig. 9, and the voltage gradient on the inner layers of the insulation is higher than the voltage gradient on the outer layers. The difference between the inner and outer stresses depends on the ratio of the inside diameter to that of the outside diameter. Thus when making tests for dielectric strength the values obtained with tubes are different to values obtained on the same material in flat plates. Some test results which illustrate this difference are shown in Table I.

5.—Duration of Application of Voltage.

As the leakage currents through the insulation represent an energy loss proportional to I^2R (I being the leakage current and R the insulation resistance), the quantity of heat energy supplied to the insulation is proportional to the time during which the voltage is applied. As electrical insulating materials are usually very bad conductors of heat, and as they are in service in contact with metallic surfaces which may be at a higher temperature than the insulation, the latter cannot dissipate the heat generated by the leakage currents until a considerable temperature gradient has been set up through the insulation. It therefore follows that until a steady temperature gradient has been established, the temperature of the insulation will increase as the voltage is applied for longer and longer time. In fig. 11 are given the results of some tests carried out on a micarta cylinder, whilst other test results on oil-treated fullerboard are shown in fig. 12. As the thickness of the insulation is increased, so will the hot spot temperature be increased, and consequently the decrease in dielectric strength for a given time of application of the voltage will increase as the thickness of insulation is increased.

(To be continued.)

Miners' Safety Lamps.—The Board of Trade has approved the following types of electric safety lamps for use in coal mines:—The "Beam" cap lamp (Messrs. William Paton and Co., Grafton Street, Glasgow); the "Adams" hand lamp (Messrs. Adams Bros. (Longton), Ltd., Baywood Works, Longton); for the use of officials, the "Thor" shaft and roadway lamp, type "M" (Thor Electric Safety Lamp Co., Ltd., Thor Works, Birmingham); and the "Ceag" shaft and roadway lamp ("Ceag" Miners' Supply Co., Ltd., Barnsley).

Gas Cylinders.—The Department of Scientific and Industrial Research informs us that the first report of the Gas Cylinders Research Committee has been issued; it gives the conclusions and recommendations of the Committee on the types of gas cylinders which should be employed for the storage and transport of compressed gases which are not in the liquid state in the cylinder. Copies may be obtained from H.M. Stationery Office, price 7s. 6d. (post free 7s. 9d.).

A LARGE STYRIAN HYDRO-ELECTRIC SCHEME.

We have received from the Styrian Water Power and Electricity Co., Ltd., of Graz, a copy of the company's prospectus, together with a report issued by the Anglo-Austrian Bank on the company's project for the utilisation of the water powers in Styria. The company, whose title is abbreviated into that of Weag, was formed in March, 1921, as the successor of the Company for the Preparation of the Exploitation of Styrian Water Power, Ltd., and its share capital of 20,000,000 Austrian crowns was subscribed by the Provincial Government of Styria, the city of Graz, and by industrialists in Styria. A sum of 6,000,000 crowns is stated to have already been expended on preparatory work in the past two years.

The object of the company is to develop Styrian water powers, and thus provide a substitute for pit coal, which for the most part is being imported at great expense and to the detriment of the Austrian exchange. The prospectus states that uniformity in establishing the works will be assured by the Provincial Government of Styria, which has the sole legal power to grant concessions, "reserving exclusively for this company the water-power concessions included in the Weag scheme." The report of the bank is a little more definite on the subject of the title to the concessions. It states that the province of Styria has reserved to itself all rights of granting concessions, "and has combined all important water-power concessions similar to a monopoly in a limited company"—the Weag—in which the province itself is a shareholder.

A general scheme for the development of the water powers has been prepared, and is set forth in a memorandum by Herr Hofbauer, an engineer in the service of the Department of Public Works. The scheme comprises: (1) Four low-pressure works in the valley of the Mur, namely, those of Bruck-Mixnitz, Judenburg-Zeltweg, Puntigam-Werndorf, and Peggau-Weinzodl; (2) high-pressure works on the Teigitsch, together with a storage lake or reservoir to provide for maximum loads and for compensation, as well as storage plant on the Teichalpe; (3) the Enns works in the valley of the Enns, power plants on the Erzbach and the Radmer, together with storage plant on the Leopoldsteiner lake; and (4) power works and storage plants on the Soelk and Tal brooks, which are to be supplemented by steam generating works as reserve in the Koeflach or another lignite district in Styria.

It is proposed to interconnect the generating works, as well as the principal areas of consumption, by means of high-pressure mains at 60,000 to 100,000 volts, and uniform working is to ensure the highest possible efficiency so as to bring the working expenses down to the lowest possible level. In this connection the high-pressure works and the storage plant installations will have to make up for any deficiency in the output of the low-pressure plants in the event of a shortage of water, while the steam generating plants will act as a reserve in case of a breakdown elsewhere, as well as on occasions when an extraordinary demand may arise. When all these works have been completed, which is expected to occupy a period of fifteen years, the Styrian hydro-electric works will be capable of a total production of 450,000 h.p., or about one-fourth of the water power which may be profitably worked in Austria; and it will be possible to supply approximately 1,000,000,000 kWh per annum.

After reading such a comprehensive scheme, it is somewhat disappointing to find that the first operations to be undertaken by the company are merely to be the erection of the projected works on the lower Teigitsch and a participation in the establishment of a steam reserve generating plant of 1,500 h.p. at the existing electricity supply works of the City of Graz in order

to meet the pressing requirements of the latter. The former works is expected to be completed within three years and to have a winter output of 10,000 kW. The annual production is put at 50,000,000 kWh, and the City of Graz has entered into an agreement guaranteeing to take a supply of 5,000 kW.

It was estimated on the basis of the prices prevailing "in the winter of 1921" that these first two installations would involve an expenditure of 2,000,000,000 crowns. To provide this amount the prospectus states that a total nominal capital of 900,000,000 crowns is now being offered for subscription in the form of one-third each in 5 per cent. debenture stock, 5 per cent. preference shares, and ordinary shares. It is however, not explained how an amount of less than one-half the computed outlay on these two installations is to defray the total expenditure on them. As to the general scheme, it is mentioned that the considerable funds for developing the works in general will be provided by the company or by subsidiary companies.

The Weag calculates that the costs of construction of the works, reckoned on a gold basis, will be essentially less than in countries with a sound currency, owing to the low wages and prices of natural products when expressed in a good currency. In order to provide against the risks to which an undertaking whose capital is being raised in paper currency is exposed owing to fluctuations in the cost of building, "the prices charged for energy will be kept within limits economically justified as high as possible," the Provincial Government for the time being waiving its right of fixing charges. Acting in agreement with consumers, according to the prospectus, the Weag proposes to realise net profits in excess of the normal, so as to be able to write off the original expenditure. In fact, the net earnings have been exempted by law from taxation until three-fourths of the original cost of construction has been written off. The right of the province to fix the charges, taking into consideration a minimum yield of 6 per cent., is not to come into force until the capital expenditure has been written down to one-fourth of the original amount. The ordinary shares are to be redeemed within ninety years, at the end of which the company's concessions will expire.

Again referring to the report of the bank on the subject, we find it stated that the financial scheme provided by the syndicate for the placing of the issues of the company is original and is based on the principle that a yield which is independent of the fluctuations in the currency is urgently needed in Austria—a yield which in spite of the high taxation shall be returned in its entirety to the investor. It has therefore been arranged with the Province of Styria that, as a rule, consumers shall pay such a price for the energy that the shareholders shall, after all taxes have been paid, receive a dividend of at least 6 per cent. This dividend, however, is not to be paid on a fluctuating face value of crowns, but as interest on the real value of the shares, which is to be established by valuation in a stable currency, as, for instance, in Swiss francs. The prospectus probably puts the matter in a more distinct light. It states that at the beginning the ordinary shares will receive 6 per cent. on the nominal value of the ordinary share of 200 crowns, namely, 12 crowns, plus a bonus at a rate corresponding to the difference between 12 crowns and 6 per cent. interest on their real value (calculated on the basis of a stable currency) at the exchange rates which have been current during the financial year.

As foreign investors are also being invited to subscribe for the present issue of 900,000,000 crowns in debenture stock and in preference and ordinary shares, it is necessary to point out that the new principle of proposing to make consumers pay sufficiently high prices to yield 6 per cent. in a stable currency or par currency, which is what it comes to, has yet to stand the test of experience and prove whether it will work in practice. No intimation is given as to the approximate price which would have to be charged to attain this result, or as to whether any prospective large consumers would be willing to bind themselves to an unknown price or expense. Everything would depend upon whether or not it would be possible for the company to supply energy at a price which would permit it successfully to compete with foreign coal as a source of energy, with imports of petroleum and benzol, or with the native lignite. This matter represents an element of doubt which it would perhaps be impossible for those outside Austria to solve. While foreseeing that in future years there should be a fairly large scope for the undertaking, provided that the supply price is competitive, in the direction of supplying the requirements of industries which need developing, the working of the railways, &c., it has to be noted that the prospectus only mentions one contract which has been concluded for the delivery of power. This is, as previously stated, with the City of Graz, and the city is itself interested in the undertaking.

THE POSITION IN THE BUILDING INDUSTRY.

In any consideration of the present position or the future outlook in the building industry, it is essential to bear in mind that under normal conditions its prosperity or otherwise is to all intents and purposes entirely dependent on the state of the other industries of the country. In times of depression, when the demand for commodities slackens, it is obvious that new factories, warehouses and such-like buildings, or extensions to buildings of that character, are not required to such an extent as when the general trade of the country is good, and even if such buildings are urgently required to replace existing out-of-date ones the money is not available for their erection. The same economic forces apply to other classes of buildings, for the capital with which country houses and "luxury" buildings are erected is mainly derived from industry, and without general industrial prosperity they are not proceeded with to any considerable extent. Conversely, when trade is good, new factories and extensions are built not only to satisfy urgent demands, but also to provide for possible future requirements, and money is available for "luxury" building to be indulged in. And just as the building industry is dependent on the other trades of the country, so the electrical industry is to a large extent dependent on the building industry for its prosperity, for unless new buildings are erected the demand for electricity does not increase to any appreciable extent (affecting central stations, plant manufacturers, and cable makers), and there is no call for the services of the contractor so far as new installations are concerned or for the products of the manufacturers of fittings and accessories for new work.

These economic laws may be clearly seen in the history of the building industry since the Armistice. For a couple of years after that date the country experienced a period of extraordinary prosperity, when, although wages were high, unemployment hardly existed. The purchasing power of the general public was on a high level, and there was a great demand for goods which it had been difficult or impossible to obtain during the war. As a direct result, factories were put up almost regardless of cost to cope with the demand for commodities, and the services of the building industry were in urgent demand. In addition, private building operations had been stopped during the war, and much leeway had to be made up in that direction; also, the Government launched the biggest housing programme in the history of the country. A further factor in the prosperity of the building trade during that period was

the Excess Profits Duty, for, as is well known, a very large amount of building construction and alteration and repair work was put in hand with the express intention of lessening the assessment for that tax. Under these conditions the demand for the builder's services considerably exceeded the capacity of the industry to cope with the work, with the result that the industry was fully employed at high prices. Then came the general slump in trade, with its inevitable effect on the building industry, and, in addition, the Government stopped its housing programme. Money became scarce, and the building public thought twice before investing in building operations. Instead of the demand for the builder's services exceeding the supply, the reverse was the case, with the result that unemployment, which had been practically non-existent in the building trade since the war, began to appear, and whereas previously often no tenders at all were sent in for advertised work, it is now common for upwards of thirty tenders to be submitted for a contract. So far as small house property is concerned, the Rent Restriction Act has rendered this class of building such an uneconomic proposition that at the present time the speculative builder is practically out of business.

But the factors which ordinarily account for the success of the building industry have been affected by the war, which has left an enormous amount of building work to be done, not only in the shortage of dwelling-houses, but also the building and remodelling of factories and other buildings, the building and redecoration of large houses, &c., while the present trade depression is keeping back the money with which this work should be carried out. At present we are faced with the anomaly of an industry in a state which may perhaps best be described as stagnation, while at the same time there is a vast amount of work urgently requiring its services. Office buildings, alterations to factories (in many cases entire rebuilding) in order to bring them into line with modern ideas of economical production, dwelling-houses, large and small—all are pressing necessities for the well-being of the country. True, considerable building activity is noticeable in central London, but it is mostly office building, which is made a more or less profitable investment owing to the high rents obtainable for such accommodation. Generally, the trade is at a standstill, and builders' yards up and down the country are stocked with plant which is bringing in no return.

A realisation of these factors which affect the building industry shows that no great revival can be expected until there is an improvement in the general trade of the country, on which it depends for its work, and until that takes place the schemes that can be seen in practically every architect's office waiting for a favourable opportunity to be carried out will remain in that stage. The high cost of building is exercising the minds of many, and is undoubtedly causing much work to be held up. Compared with 1913 prices, the cost of building shows an increase of up to about 150 per cent., while the official figures indicate that the cost of living has fallen to about 75 per cent. above the pre-war level. It has to be borne in mind, however, that the cost of his work is largely outside the control of the builder. The builder acts as a middleman in the sense that he purchases materials and labour and supervises the erection, and the ultimate cost is therefore the cost of the material and labour, plus profit. No doubt during the boom period profits were high, but at the present time we know of several large contracts recently entered into at prices which leave no profit at all unless the prices of materials and labour are considerably reduced before the work is finished—with the slackness which exists in the industry to-day, and the resulting keen competition, it is obvious that excessive profits cannot be added to tenders. The cost is practically governed by the cost of the component parts of a building and the labour required for its erection; the former show increases of anything up to 200 per cent. over 1913 prices (the largest items, bricks and cement, are from 100 to 150 per cent. up), and labour, which accounts for half the cost of building, has increased by 150 per cent. It is obvious, therefore, that the cost of building, which has already been reduced considerably during the past few months, cannot be further reduced until the cost of materials and labour is reduced, and while the latter is controlled by an agreement between the masters and the trade unions, the bulk of the former is controlled by trade combines and associations of manufacturers which fix prices, and, incidentally, prevent the builder from using his business abilities to purchase in the cheapest market and thereby being in a position to tender below his rivals. There are, however, hopeful prospects that both these costs will be considerably reduced in the near future; the one owing to unemployment, which will undoubtedly induce the men to accept lower wages, and the other owing to the large stocks the manufacturers are accumulating as a result of the slackness in the building industry. But it is this expected reduction which is having a marked effect on the amount of work being put in hand, for no one, unless he is compelled, will buy on a falling market, and many prospective clients are waiting until prices have reached rock-bottom and a certain degree of stability. The slowness which has been so noticeable in all building operations since the war has also added to the reluctance to embark on building projects, but the output of the workers has shown a welcome improvement during recent months, and, with the keener competition for work owing to the prevailing unemployment, will no doubt still further increase.

The general consensus of opinion in the industry seems to be that the present general depression will continue for some months to come, but that towards the end of this year a revival may be expected, and with it a revival in the building industry. Until that takes place, and until building costs have reached some sort of stability, it is unlikely that large building programmes will get beyond the paper stage, but when it does come about there are signs that the activity of the building industry will rival, if it does not exceed, that which followed immediately after the Armistice. The prospects of the country generally, however, are the only barometer by which the prospects of the building industry may be gauged.

H. C.

The Engineering Industry in France.—According to a Reuter Trade Service dispatch from Paris, the improvement which for some time has been noticeable in the metallurgical industries in the Lyons district continues. The construction of machinery is being aided by the demands for the installation of power stations along the Rhone and its tributaries. The orders given by railway companies for locomotives and rolling stock, and for repairs to material, have recently been so numerous that certain works are short of skilled hands. On the other hand, the position in the machine-tool industry is still anything but satisfactory. Metallurgical works are profiting by the resumed activity of the chemical industries, but the situation in the boiler trade is regarded as serious. Cast iron and steel foundries are receiving a certain number of orders, and, although fewer workers are employed than in a normal period, work is active. Copper foundries are also more active. Motor-car construction maintains its activity as far as luxury cars, tourist cars, and small industrial cars are concerned, but business in big lorries is very slack. One important establishment is closing its Lyons works and dismissing its personnel. Orders are being received in the electrical industry, and skilled workers are lacking in certain categories. At Villefranche-sur-Saone motor-car construction, machinery works, and foundries are all active, and at Givors the machinery industry is normal while the glass-making industry shows some improvement. The delay in the delivery of industrial coke by Germany and the disturbance to trade caused by the German railway strike have had a serious effect on the metallurgical industry of Lorraine. A certain number of works at Thionville d'Hayange and Hagondage have been obliged to allow their furnaces to cool. As regards the general situation in France, it is estimated that 40 per cent. of the blast furnaces are working. The proposed electrification of the P.L.M. and Orleans railways is likely to provide work for the metallurgical trade during the coming year, since something like 2,000 electric locomotives will be needed, and the erection of power stations and the construction of the transmission system will provide employment for many.

A NEW FREQUENCY METER AND STATION TACHOMETER.

By R. C. CLINKER, M.I.E.E.

A FREQUENCY meter* working on a new principle, and which possesses several advantageous features, is being put on the market by the British Thomson-Houston Co., Ltd.

The principle of action is that by which a coil in a circuit containing inductance and capacity will, when suitably arranged, automatically adjust its inductance to resonance with the impressed frequency. This self-adjustment is utilised to indicate the frequency.

To understand the action of the instrument, consider the forces acting between two coils, one fixed and connected to an alternating-current supply, and the other movable, and either (1) short-circuited, (2) connected to an external inductance, or (3) connected to a condenser.

In the first case, where the soil is short-circuited, the force is repulsive, owing to the fact that the phase of the current in the secondary or moving coil is displaced nearly 180° from that in the fixed or primary coil. This condition is well illustrated by a well-known experiment in which a solid ring is driven off an iron core when the latter is magnetised by alternating current.

In the second case, with an external inductance connected, the result is the same, viz., repulsion from the primary. The magnitude of the force, however, is less

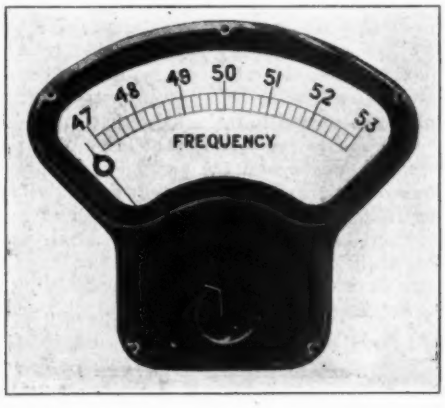


FIG. 1.

than in (1) owing to the reduction of current in the secondary.

In the third case, with a condenser connected, the secondary may experience either repulsion or attraction, depending upon the value of the condenser capacity. If the condenser has a small capacity, so that the capacity reactance is greater than the inductive reactance, the current in the secondary will be nearly in phase with that in the primary, and the coils will attract. If the capacity be large, so that the inductive reactance preponderates, the currents will be in opposition and the coils forced apart. The force disappears, however, when the capacity and inductive reactances are equal, *i.e.*, when the secondary circuit is in resonance with the impressed frequency. With this condition, the two currents are in exact quadrature, and the mean force is zero. Any change of frequency, however, either up or down will cause repulsion or attraction, and the secondary coil will move away from or towards the primary.

If, now, it can be so arranged that when a variation of frequency causes the coil to move, the inductance or capacity changes in the right direction, then the coil will again find a position of zero torque for the new frequency. One way of accomplishing this is to thread the moving coil upon an iron core projecting from the fixed coil, and pivot it freely. With this arrangement, the effective inductance of the moving coil increases as it nears the fixed coil, and its natural frequency therefore decreases. This is the effect required, for when the impressed frequency falls, the coil tends to move towards the fixed coil, and it therefore finds a new position of resonance for every frequency within its range. To use a wireless term, the coil automatically "re-tunes"

*Patented.

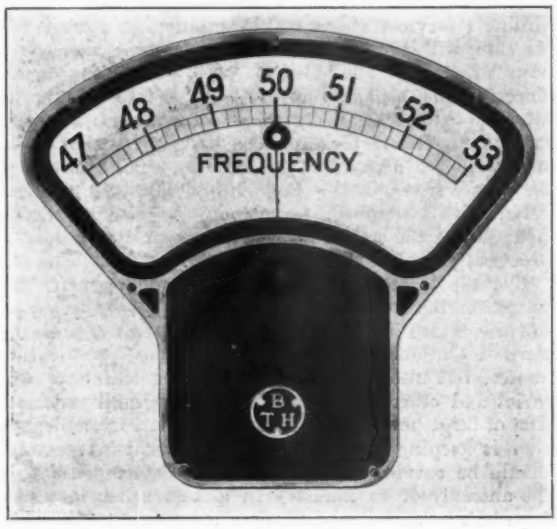


FIG. 2.

its circuit for every change in impressed frequency. As the position of the coil when in resonance is always one of zero torque, it is not affected by the magnitude of the primary current, *i.e.*, by the impressed voltage. The arrangement, therefore, makes an excellent frequency

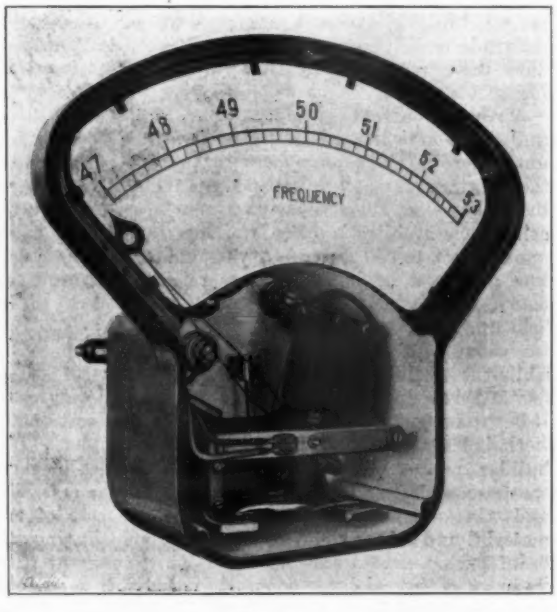


FIG. 3.

meter, as the position of the pointer attached to the pivoted coil depends upon frequency only.

The distance moved by the coil for a change of one cycle per second depends upon the rate at which the inductance of the secondary circuit changes with its position on the core. If external inductance be added, the coil will have to move a greater distance for a given

change of total inductance, and the scale will be opened out. By this means an instrument is produced which has a very open scale. It is an easy matter to obtain a scale having a distance of two inches for a change of one cycle per second. Such a scale is shown in fig. 1, which illustrates a sector-pattern instrument having a 12-in. scale. Fig. 2 shows an instrument with an 18-in. scale for use as a "station tachometer," which can be accurately read at a considerable distance. The scale length per one cycle on this instrument is three inches, which is sufficient to enable the station speed to be observed from any point.

ERRORS.—The error due to variation of voltage is, for the reasons given above, negligible over a range of from 50 to 150 per cent. of normal pressure.

Variation of resistance of the moving-coil circuit due to temperature change has no effect, as the phase of the current is unaffected; its magnitude only is changed.

The error due to distorted wave form is very small, and negligible in practice. That this must be so will be appreciated when it is considered that, in the first place, owing to the high inductance and low resistance of the fixed coil, the flux due to any voltage harmonic is less than that due to the fundamental, in the ratio of the fundamental frequency to that of the harmonic. For instance, a 10 per cent. harmonic of three times

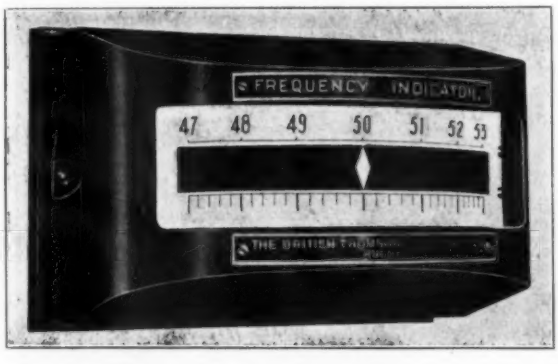


FIG. 4.

normal frequency produces only 10/3 or 3.3 per cent. of the flux due to the fundamental. Further, this flux can produce but a small harmonic current in the moving coil, because the circuit of the latter is completely out of tune with it. Tests showed that even with a 40 per cent. harmonic artificially introduced, the error was only 1/4 cycle in 50.

Fig. 3 gives a view of the instrument with its cover removed. It will be noted that a curved iron core is used to provide a large angular movement. Also a device is fitted which automatically pushes the pointer off the scale when the voltage is cut off.

Fig. 4 shows a horizontal edgewise type of instrument having a 6-in. scale.

From what has been said above, it is clear that the instrument can also be constructed as a capacity or an inductance meter. For these uses it is supplied with alternating current at a fixed frequency. Instruments have been constructed for checking small condensers such as are used for magnetos, the scale range being 0 to 0.25 microfarad. In this case a fixed condenser is connected to the moving coil to cause the pointer to stand normally at zero, thus providing a restoring torque.

The chief features of the new instrument are summarised as follows:—

(1) An extremely open scale may be obtained around the working point
(2) The reading is independent of voltage over a wide range.
(3) The reading is affected very little by distortion of wave form.
(4) The restoring torque is large.
(5) The parts are few and robust, and the instrument is unlikely to get out of order.

LEGAL.

WORKMEN'S COMPENSATION.

IN the Mayor's and City of London Court, on January 9th, Augustus Clark, assistant electrician, Stratford, claimed compensation from Colonial Wharves, Ltd., 37 and 38, Mark Lane, E.C., for injuries which he sustained while working for them. He was assisting in lowering a portable crane by means of a transporter when stops holding the crane slipped. His right foot was injured. He was paid 35s. a week from December, 1920, to September of last year, and then the employers thought he was sufficiently recovered to resume his former work. He complained that he still had pain. Defendants were willing to pay £59 in full settlement, which plaintiff was willing to take, subject to the Court's approval. Judge Atherley-Jones, K.C., approved.

COMMERCIAL TRAVELLER'S CLAIM.

IN the Mayor's and City of London Court, on Thursday, before Mr. Registrar Dell, a claim was made by R. S. Butler, a commercial traveller, against the B.T.T. Electric Lamp and Accessories Co., London, E.C., electric lamp agents, for £3 10s., salary and expenses in lieu of notice. Plaintiff said about October 20th last year he was employed by Mr. Taylor, of the defendant company, as a traveller and representative at a salary of £3 per week, 10s. for expenses, and 2½ per cent. commission, and a week's notice each way. The reason given for his dismissal was that on the Friday of the first week of his employment he was told to see Mr. Ayton, the defendant's sales manager. He waited until ten minutes past seven, and then, thinking he had waited long enough and that Mr. Ayton had gone for the day, he left. On the Saturday he was told he ought to have waited, and he received his week's salary. On the Monday he was told he could not start again. He claimed he was entitled to notice, which he had not received. For the defence, Mr. Ayton was called, and he said that he had engaged the plaintiff, who was told by him (witness) to carry on, and that it was to be a week on trial. Witness admitted, in answer to the Registrar, that Mr. Taylor had told him (witness) he was sending the plaintiff to him for approval. Mr. Registrar Dell said it was clear that the defendants had come along with the wrong witness. The defendants' witness who had been called only knew of the terms of the plaintiff's employment by Mr. Taylor by conversation. Plaintiff denied that he was engaged for a week on trial. Under the circumstances he thought the plaintiff was entitled to a week's notice, and he gave judgment for him for £3, disallowing the claim of 10s. for expenses, which had not been incurred.

CARRS *v.* FAWCETT.

THE *Liverpool Post* reports a case heard at the Liverpool Court of Passage on January 6th, in which Messrs. Carrs, partnership agents, of Liverpool, claimed £25 commission from Ernest Fawcett, of Fawcett & Hastings, electrical engineers, for the introduction of a business partner to the defendant. Evidence given for the plaintiffs by W. Porter, a member of the firm of Carrs, was to the effect that at the beginning of last year defendant, who was then managing-director of the Stoneycroft Electrical Works, Ltd., entered into an agreement to pay 10 per cent. commission for the introduction of a new director and fresh capital into the business. Before plaintiffs were able to discharge their undertaking the Stoneycroft works went into liquidation. Shortly afterwards Mr. Porter met Mr. Fawcett, who after indicating that he was acquiring the effects of the Stoneycroft Electrical Co., requested plaintiffs, it was alleged, to find him a partner with capital. Later Captain Hastings joined defendant in his business, and plaintiffs claimed that it was a result of their introduction.

Defendant denied that he gave Mr. Porter the verbal instructions to find him a partner, and contended that the agreement only related to the firm which went into liquidation. He had himself, he said, advertised for a partner in trade journals.

Judgment was given for plaintiffs for the amount claimed.

Easier X-ray Diagnosis.—The great advance in the taking of X-ray photographs in this country has made it possible to obtain radiographs of the thickest parts of the body in which the details and definition are extraordinary. Wonderfully clear photographs are taken with ordinary apparatus, with a moving grid made up of parallel strips of lead, a combination of devices made by Mr. Buckley, the originator, and Dr. Hollis F. Potter, of Chicago. X-ray photographs, particularly those taken through thick parts of the body, are frequently "fuzzy" owing to the scattering of the rays, but the lead grid intercepts these almost completely. By swinging the grid to and fro its image does not appear in the photograph, the improvement in which renders diagnosis far easier.—*Daily Mail.*

THE PHYSICAL SOCIETY OF LONDON.

TWELFTH ANNUAL EXHIBITION.

The twelfth annual exhibition of electrical, optical, and other physical apparatus, held under the auspices of the Physical Society of London and the Optical Society, was again housed in the Imperial College of Science and Technology at South Kensington last week and as usual proved a great attraction; its popularity may be gauged from the fact that the supply of admission tickets failed some time before the opening date. The show lasted two days, and during that time several discourses took place: Mr. Alan A. Campbell Swinton, F.R.S., lectured on "The Johnsen-Rahbek Electrostatic Telephone and its Predecessors;" Mr. F. Harrison Glew took as his subject "Radium: its application in Peace and War;" while the Astronomer Royal, Sir Frank Watson Dyson, F.R.S., F.R.A.S., explained the "Employment of Coarse Wire Gratings in Astronomy." Many of the exhibitors demonstrated the function of their devices and much electrical and other apparatus was on view; it would require more space than is at our disposal wherein to describe it all, so a general review of the more interesting exhibits must suffice.

Mr. J. Scott-Taggart exhibited his negatron oscillator, which is a source of continuous oscillations, especially for use in the reception of continuous waves. The components of the circuits are enclosed in a polished wood case fitted with a slanting ebonite panel, on which are mounted adjusting handles and a wave indicator, as shown in fig. 1; the case is similar in shape to the standard wireless telegraph receiver, but is narrower. The wave indicator is of the same type as that provided on the standard receiver, and the operator can see at a glance the length of wave that is radiated by the oscillator; the range provided is from 600 to 20,000 metres. A single negatron valve of special type, possessing four electrodes, is mounted within the case, and, as a protection against the valve being left burning when not required, an inspection window covered with red glass is provided above the wave indicator. The valve derives both filament and anode currents from the same batteries used for the receiver valve, the filament current being controlled by a rheostat that is mounted on the face of the instrument, together with a switch for extinguishing the valve when not in use. The negatron oscillator may also be used as a continuous wave wavemeter or for any like purpose; it is handled by the Radio Communication Co., Ltd., and was described on p. 449 of our issue of September 30th, 1921.

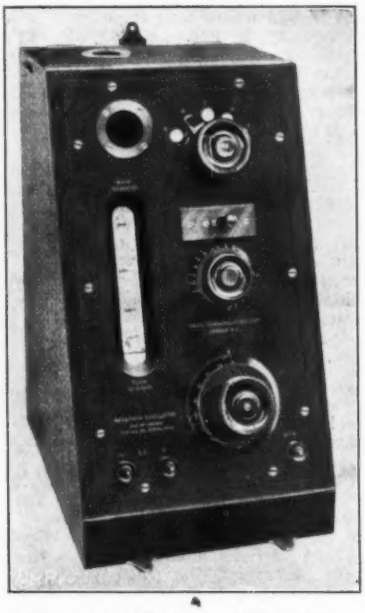


Fig. 1.—A Negatron Oscillator.

Messrs. Newton & Co. exhibited projection lanterns and various illuminants, including arcs and metal-filament gas-filled lamps.

Messrs. C. F. Cassella & Co., besides Dr. J. S. Owen's automatic air filter for measuring the suspended impurities in air, had on view an anemometer and wind direction indicator, by means of which the velocity and direction of the wind are indicated on a dial by electrical means, the direction of the wind being shown by a number of small glow lamps.

Messrs. A. W. Penrose & Co., Ltd., showed a "Daylight" *lantern* that was fitted with screens of tinted glass for modifying the colour of the electric incandescent lamps so as to simulate natural daylight and enable colours to be matched.

The Edison Swan Electric Co., Ltd., showed an electric *lamp* for the same purpose as that mentioned above; in this case, however, the bulb itself was blue in colour, and no screens were used. "Fullolite" lamps, having opal bulbs to prevent eyestrain, were also to be seen, and a variety of "Pointolite" lamps for different purposes, ranging in size from 30 to 10,000 c.p., some of which had a fixed focus, some a high intrinsic brilliance; some of the bulbs had a reflector fitted inside them, while others were pipless.

Mr. R. W. Paul's fundamental standard of mutual inductance, which is destined for Japan, is illustrated in fig. 2. Its design, evaluated from its geometrical dimensions, is due to Mr. Campbell, and special care has been directed to permanence and ease of setting up. Its construction was commenced in 1911, but was interrupted by the war. The primary is of bare wire wound in a screw thread cut in a marble cylinder, and has two equal sections, each of a single layer, with a space between their inner ends. The secondary is a multi-layered coil wound in a groove in a marble ring; it surrounds the cylinder, and is adjustable both axially and radially in relation to the latter. It is set mid-way between the two primary helices, and has a mean diameter such that the field due to the helices is zero at the mean circumference; thus, for a given displacement from the correct position the change of mutual inductance is a minimum.

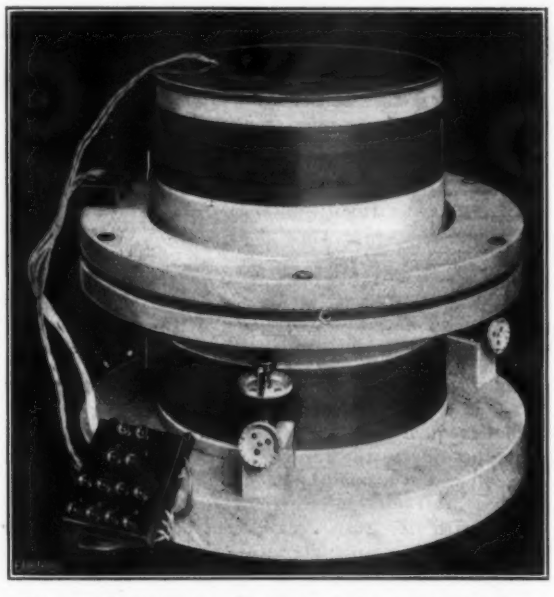


Fig. 2.—Fundamental Standard of Mutual Inductance.

Curves were exhibited, showing variations of diameter and pitch of the primary, as measured by the Metrology Department of the National Physical Laboratory. Calculated curves were also shown giving variations of mutual inductance with the above, and with variations of the diameter of the secondary. These curves and the final calculations of value (10.0071, millihenries) were made by the Electrical Standards Department.

Messrs. Adam Hilger, Ltd., in addition to other things, showed an optical sonometer for the purpose of making photographic records of the forms of sound waves, and designed to assist in the diagnosis of faults in geared turbines and other rotating machinery. The sound waves are directed down a metal trumpet on to a diaphragm, the vibration of which causes a spot of light that is focused on to a revolving sensitive kinematograph film to flicker up and down, thus producing a record similar to that of an oscillograph. The novelty of the device consists principally in the sensitive film, which is made of celluloid covered with gold, and has a thickness of less than a wave length, so eliminating to a great extent the "thickness effect" of the diaphragm.

Messrs. Watson & Sons (Electro Medical), Ltd., had on view an X-ray outfit that consisted of a "Sunic" combined radiographic couch, screening and tube stands, which was fitted with a new 1.8-kW oil-immersed h.p. transformer capable of delivering a secondary pressure of 60,000 volts, and made suitable for operating a 10 or 30 m.a. self-rectifying

electron tube. There was also a "Canny Ryall" portable diathermy device on the firm's stand which was specially designed for operations in conjunction with a cystoscope, but the apparatus was suitable for general diathermy treatment, and was manufactured so that it could be attached to any a.c. circuit of either high or low voltage, but if it is required to operate it on a d.c. circuit it is necessary to employ in conjunction with it a small rotary converter.

Messrs. John J. Griffin & Sons, Ltd., amongst a variety of physical apparatus for the use of laboratories, had on view an outfit of Sand's electro-metric apparatus for the estimation of acidity.

On the stand of Messrs. Everett, Edgcumbe & Co., Ltd., was displayed a varied selection of measuring and controlling instruments, amongst which those seen for the first time may be mentioned the following:—

A particularly compact and portable alternating-current testing set for the measurement of current, voltage, and power. The set consists of two dynamometer movements contained in a single case and arranged by means of a handy change-over switch so that on one movement voltage or watts

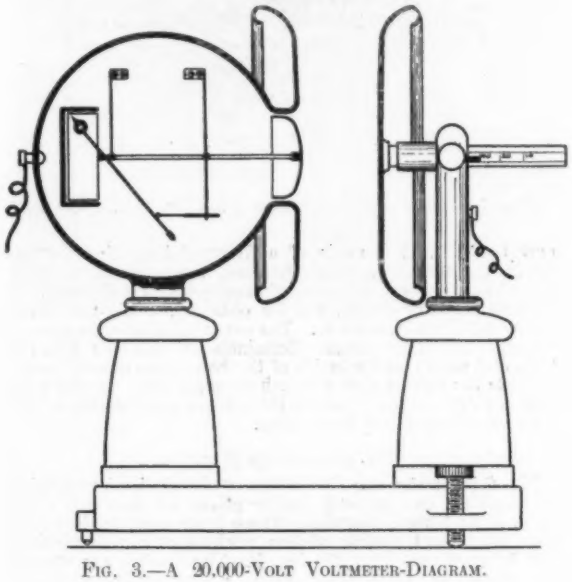


Fig. 3.—A 20,000-Volt Voltmeter-Diagram.

can be measured, and on the other amperes. By this means single and three-phase power, current, voltage, and power factor can be determined with a single instrument, and a number of voltage and current ranges may be provided, the latter by means of single or multi-range current transformers; moreover, the voltmeter can be used for d.c. voltage measurements and the ammeter for d.c. up to 5 amperes, by which means the instrument can be at any time tested for accuracy against a d.c. sub-standard instrument or potentiometer.

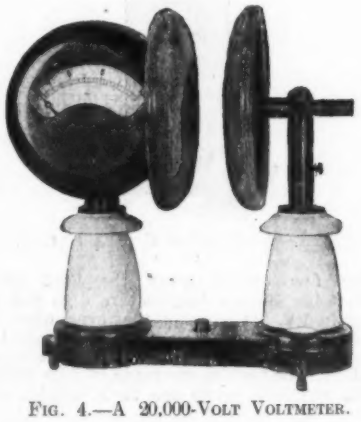


Fig. 4.—A 20,000-Volt Voltmeter.

Another compact little portable set suitable for d.c. measurements of all kinds is that known as the "Dwarf Testing Set." It consists of a moving-coil instrument with the following ranges: 3, 15, and 30 amperes; 3, 15, and 150 volts. The whole is fitted into a leather carrying case measuring only 4½ in. x 5½ in. x 2 in., and weighing complete about 1½ lb. It is the most compact set of its kind, and should prove extremely useful to factory plant superintendents, contractors, garages, &c., and to all who are concerned with the installation or maintenance of d.c. plant.

A number of measuring instruments suitable for generating station and factory use was shown, amongst which may be mentioned a new form of leakage indicator suitable for use with a system having its neutral point earthed. As is well known, the current flowing to earth through the neutral point represents the leakage on the system, and its accurate measurement is a matter of great importance. At the same time, to introduce into the earthing circuit the fine winding of a low-range ammeter is inadmissible owing to the risk of its being burnt out owing to an earth on the system. To meet this difficulty the Everett-Edgcumbe leakage indicator has been introduced, consisting of a current transformer with a heavy primary winding, and having the indicator itself connected to its secondary. By this means a scale of 0.5 amps. is furnished, although the normal earth current may be rated at as much as 100 amps., and so on in proportion. The indicator itself is provided with an automatic short-circuiting switch which serves the double purpose of protecting the winding from damage, and of serving as a tell-tale to indicate when a fault has occurred.

A number of ohmmeters was exhibited, one adapted to the reading of winding temperatures of running machines being shown in operation. The scale of the indicator is graduated up to 150 deg. C., and serves to indicate directly the temperature of a running motor. For the measurement of the temperature of the stator or other h.p. windings resistance units are embedded in the slots as near to the conductors as possible, and are connected to an indicator graduated directly in degrees of temperature.

An interesting voltmeter for the measurement of extra high voltages was shown. It is based upon the principle first employed by Lord Kelvin and subsequently developed by M. Abraham, the eminent French investigator, viz., the attraction of two oppositely electrified conductors protected by guard plates. The instrument shown had a maximum range of 40,000 volts, with additional ranges of 20,000 volts and 10,000 volts. It is illustrated in figs. 3 and 4, and it

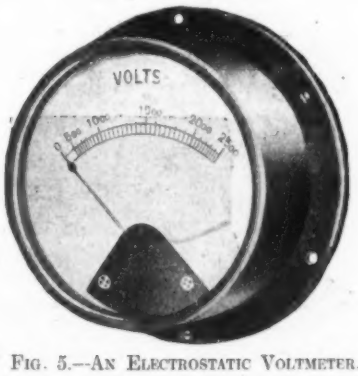


Fig. 5.—An Electrostatic Voltmeter.

may be added that similar instruments are supplied for all pressures up to 200,000 volts. The change-over from one range to another is immediately effected by altering the distance between the plates. An important feature of these voltmeters is that, air being used exclusively as the dielectric, they give identical readings with direct current or alternating currents of any frequency, which is not the case with electrostatic voltmeters depending upon the use of condensers, which instruments are also liable to disturbance through variable leakage affecting the distribution of potential between the instrument and the condenser in series with it.

In the past the electrostatic principle has been considered as suitable only for comparatively large dial instruments, but Messrs. Everett, Edgcumbe have found it possible so far to reduce the dimensions that a 3-in. dial electrostatic voltmeter reading up to 2,500 volts has now been evolved, and is very largely used for wireless installations where space and weight are often of great importance. One of these instruments is illustrated in fig. 5.

Messrs. Muirhead & Co., Ltd., had in operation a Heurtley four-wire magnifier, which depended upon the variation of resistance due to temperature caused by the proximity of electrically-heated wires, amplified the incoming telegraphic impulses from the cable, and thus increased the speed of operation. The instrument is a modification of the original magnifier bearing the same name, and is used by many cable companies on their longest cable sections; its use results, it is claimed, in an increase of speed in duplex working of from 25 to 50 per cent. in each direction above plain recorder working. An artificial-line box represented the electrical constant of a submarine cable, and was used to obtain the necessary balance for duplex working. The automatic transmitter used was governed so as to obtain constancy of speed.

Messrs. Elliott Bros.' (London), Ltd., exhibit comprised a complete range of indicating and recording switchboard and

portable instruments, test sets, Wheatstone apparatus, galvanometers, Wheatstone bridges, chemically-engraved nameplates, small motors for telegraph work, steam and oil engine indicators, tachometers, frequency indicators and vibration tachometers of the resonant reed pattern, a ship's electric log as used in the British and other navies, gyrostat parts as used in gyro compasses for marine work, &c. We particularly noticed the "Multiversal" testing set, fig. 6, which is an improved design of the well-known "Century" mains test set. Its range has been very considerably extended, and it is now direct reading from 0.75 millivolt to 1,200 volts, and from 1 micro-ampere upwards to any amount of current, the higher ranges of

Fig. 6.—A "Multiversal" Testing Set.

current being measured by means of external shunts. The instrument is provided with an arrangement whereby an external dial can be inserted in the variable arm of the Wheatstone bridge portion of the apparatus when measuring resistance, so that its range may be extended ten times. The set is now sent out with a booklet, containing instructions and diagrams of connections for making the various tests. The workshop ohmmeter is a new instrument having a double range, and provided with the necessary terminal board for

Fig. 7.—A "Unit" Test Set.

attaching the resistance to be measured. It gives a direct reading in ohms, and can be calibrated for ranges up to 10,000 ohms. We also noticed a series of moving-coil instruments in pressed-metal cases, with either open dials or the ordinary enclosed dial with a metal front, having 120 degrees angular deflection. These instruments have the same scale length as dial diameter, thus an 8-in. instrument has an 8-in. scale. The "Unit" test set, fig. 7, consists of a precision moving-coil instrument, and is arranged with separate shunts and series resistances for measuring current and voltage up to any amount. The instrument itself is considerably more sensitive than the usual millivoltmeter and has a high resistance. It gives a full scale deflection for 45 millivolts, and has an internal resistance of 10 ohms. By means of a third terminal a self-contained voltage range of 3 volts is obtained with a total resistance of 1,000 ohms.

Messrs. A. Gallenkamp & Co., Ltd., showed a selection of electrically-heated vertical and horizontal tube furnaces; also muffle furnaces, explosion tube furnaces for heating substances in sealed glass tubes, and organic combustion and crucible furnaces. The firm's electro-titration apparatus can be used for such purposes as hydrogen-ion concentration measurements (PH), preparation of accurately neutral or buffer solutions, and acid-alkali, or oxidation, titrations.

The Zenith Manufacturing Co. covered its stand with many shapes and kinds of resistances and rheostats. It also showed the "Zenith" magnetic rectifier under working conditions.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A C.T.S. Connector Box.

In our issue of June 18th, 1920, we gave some particulars of a connector box for metal-sheathed cables, designed by Mr. White, A.M.I.E.E., 1, Cumberland Street, Deansgate, Manchester. The same inventor has now adapted the idea to a connector box for c.t.s. or tough-rubber-sheathed cables. The

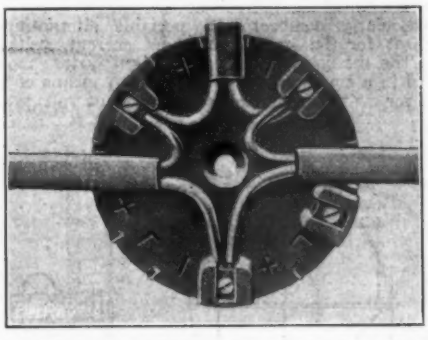


Fig. 1.—Universal Connector Box for C.T.S. Cables.

new box (fig. 1) is made of a fireproof insulating material As in the box previously described, the entry slots are so spaced that any arrangement of cables—straight through, tee, right-angle, 3 or 4-way, can be obtained, while the entries not required are covered in. The cover has four slots at equal distances round its flange. Terminals are moulded into four lugs, and marks on the inside of the bottom portion of the box indicate the correct slots for each arrangement. By the adoption of a "universal" box of this nature the stocking of four different kinds of box is obviated.

Electric Garage Heaters.

Fig. 2 illustrates one of a series of electric heaters specially designed for garages and similar places by Electric Fires, Ltd., King Street, Norwich. These have been made to provide an efficient heating system working at a comparatively low temperature, viz., 250 deg. F. The heaters are strongly constructed of steel plate (there are no easily-broken cast parts), and consist of a series of fins, which dissipate the heat generated in a number of elements clamped tightly in water-tight casings between the plates. The apparatus reaches its normal working temperature within a few minutes of switching on, and when this point is reached the convection of air

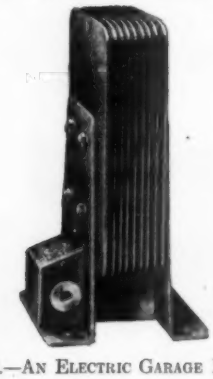


Fig. 2.—An Electric Garage Heater.

between the fins carries away the heat generated so efficiently that the surface temperature does not rise above the limit mentioned. It is stated that even when the heater has been on for a considerable time it is safe to sprinkle petrol on it, and that it can be covered with tissue paper without risk of fire. The heaters are made in four standard sizes, 250, 500, 750, and 1,000 watts and their weights range from 7 to 25 lb.

Machines for Armature Construction.

We have received from Messrs. John Holroyd & Co., Ltd., 34, Victoria Street, S.W.1, some particulars of recently-designed machines for use in the construction of armatures and commutators. Fig. 3 shows a banding lathe, which can also be used for general turning. The height of centres is 15 in., and the lathe will take armatures up to 22 in. diameter by 4 ft. 9 in. length of spindle. A reversing countershaft is provided, and the headstock spindle revolves in the

reverse direction when banding is being done. A substantial brake is provided in a convenient position to hold the spindle stationary against a maximum tension of 2 cwt. on the wire, whilst the coils of banding are being soldered by the operator. Brackets are provided at the rear of the carriage for holding a drum of banding wire, which passes under the bed to a guide pulley on the apron of the carriage. After passing through an initial tension clamp it reaches the main tension drum. It passes twice round this drum, which is controlled by an adjustable band brake, giving a smooth action and

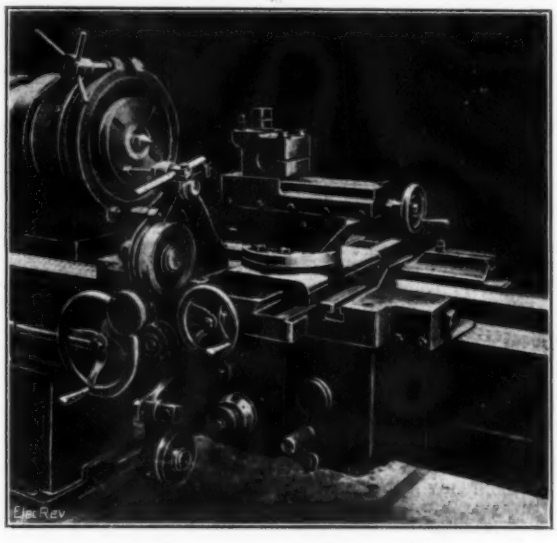


FIG. 3.—AN ARMATURE-BANDING LATHE.

powerful control up to the maximum tension required, and then continues over to the work. Eight rates of turning feeds are provided, and four rates for banding with 16 S.W.G. and finer wire, whilst nine spindle speeds give a range from 15 to 290 r.p.m. The lathe weighs approximately 3¼ tons.

Another machine is specially designed for balancing armatures, pulleys, cones, &c., and has been found in practice to be very efficient. No setting or adjusting is necessary apart from the length, and the machine can be easily moved from one part of the machine shop to another. The shaft is mounted on disks made of chilled iron and accurately ground. The pivots run in ball bearings, and so ensure extreme sensitiveness to any irregularity in balance. In a test an armature weighing 6 cwt., mounted on a 2¼-in. diameter shaft was used, and it was found that a weight of 2¼ ounces suspended 7 in. from the centre was sufficient to produce motion of the armature. The balancer can support a weight of 5,000 lb., and armatures up to 6 ft. diameter and 6 ft. long can be tested upon it.

Fig. 4 shows a machine designed for cutting down the mica insulating strips below the surface of the commutator bars. The construction embodies an up-to-date crank shaping head, with box body, in conjunction with a long bed and

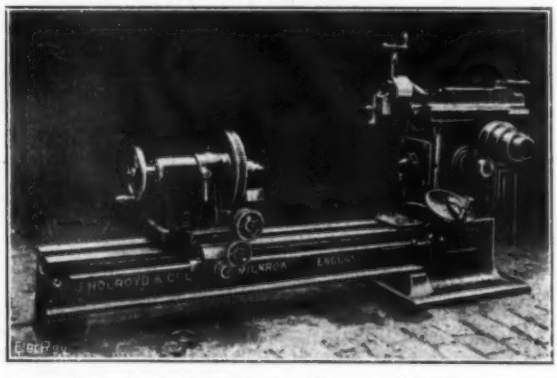


FIG. 4.—A COMMUTATOR NOTCHING MACHINE.

headstocks, that support armatures of varying length up to 4 ft. 7 in. overall and 22 in. diameter. These are mounted between the centres, with the commutator close to the shaper head, which has adjustment for length and position of stroke, and down-feed adjustment to regulate the cut, all arranged to deal with any commutator on an armature of normal design within the capacity of the machine. The loose headstock is fitted with worm-wheel dividing apparatus, controlled by a dividing arm and dial situated conveniently for the operator when standing close to the cutting tool. The machine can deal with commutators from 11 in. to 17 in. diameter by 12 in. long: it weighs about 22 cwt.

BUSINESS NOTES.

Bankruptcy Proceedings.—JOHN HOWARD HOPKINS (formerly trading as the Electrical Maintenance Co.), late of 140, Wardour Street, W.—The receiving order in this case was made at the London Bankruptcy Court on November 30th, and the first meeting of creditors was recently held before Mr. F. T. Garton, Official Receiver. It appeared from the debtor's statements that he began business on his own account as an electrical engineer in July, 1918, at 87, Shaftesbury Avenue, W.C., under the above style. It was originally intended that the business should be that of maintaining kinema electrical plant, but it developed into a kinema equipment business. The debtor provided £1,000 capital. In March, 1920, a Mr. C. A. Hale joined him in partnership and introduced £3,000, of which the debtor received £1,200 personally, and the balance was put into the business in the shape of capital. The debtor and his partner, however, were unable to agree, and it was arranged that the latter should be bought out for £5,000, of which £500 was to be paid down and the balance by weekly instalments of £40. In all £750 had been paid to Mr. Hale under that agreement. It further appeared that in consequence of the debtor's not being conversant with the equipment part of the business, various mistakes were made, which resulted in the loss of orders. A private meeting of the creditors was held, the result of which was that the debtor executed a deed of assignment, under which Mr. Oliver Sunderland, accountant, 19, Eastcheap, E.C., acting as trustee, took over the assets which the debtor estimated would produce a dividend of 12s. in the £ on liabilities of £20,000. The petitioning creditor, Mr. Julius Raymon, refused to accept the terms of the deed and instituted these bankruptcy proceedings. The debtor believed that the whole of the assets had been realised and that a dividend of 2s. in the £ had been paid, but he did not know the present position, except that the business had been closed and the effects had been sold by auction. Apart from the liabilities under the deed, the debtor owed £950 to the petitioning creditor, and he had no separate assets. The failure was attributed to loss on the trading owing to the debtor's inexperience of the business. A resolution was passed for Mr. Maurice Hyam, C.A., 60, Chancery Lane, W.C., to act as trustee and administer the estate in bankruptcy.

A. J. WILLCOX, motor and electrical engineer, The Garage, Farnham Common, Bucks.—First meeting January 16th at 20, Russell Square, W.C.1; public examination February 10th, at the Town Hall, Windsor.

BERNARD BARNETT, electrical engineer, of 104, Whitechapel Road, E., and 100, Bethune Road, Stamford Hill, N.—The first meeting of creditors under this failure was held last Friday at the London Bankruptcy Court before Mr. W. P. Bowyer, Senior Official Receiver. The receiving order was made on December 20th. The Chairman reported that the debtor had stated that in 1914 or 1915 he took a lease of a house, shop, and factory premises at 104, Whitechapel Road. In March last he executed some work at a kinema and cigarette tube machinery works belonging to Messrs. Heller and Cederman, and subsequently those two gentlemen joined him in partnership, the idea being to extend the electrical business to the West End. On July 29th last, however, they served the debtor with a notice for the dissolution of the partnership, and a receiver was appointed. The debtor estimated his liabilities at between £500 and £800, against assets valued at £800, and he attributed his present position to overconfidence in the manager, book-keeper, and partners. In the absence of a quorum the meeting was adjourned with a view to the appointment of a trustee.

R. A. DEPLEDGE, late 102 now 53, Frodingham Road, Scunthorpe, Lincs.—First meeting, January 18th, at the Official Receiver's Office, St. Mary's Chambers, Great Grimsby. Public examination, February 2nd.

Company Liquidations.—HUDSON'S ELECTRICAL ENGINEERING CO., LTD., Leeds.—The Committee of Inspection which was appointed at a meeting of creditors held in August last has not found it possible to effect a sale of the business as a going concern, and the offer of the whole of the stock-in-trade, &c., for sale by auction was not successful, as the prices offered were so low that a very large portion of the lots were withdrawn. To date the liquidator has only been able to discharge the debenture loan of £2,000 to the extent of £1,000. In the Committee's opinion there is no hope whatever of any surplus accruing to unsecured creditors, and they have accordingly left the completion of the administration of affairs in the hands of Mr. W. Emmerson, of Leeds, who, in addition to acting as liquidator, is receiver and manager on behalf of the debenture holders.

ELECTRICAL DEVELOPMENT & FINANCE CORPORATION, LTD.—Meeting of creditors January 17th at 90, Cannon Street, E.C. Liquidator, Mr. W. B. Stone. Voluntary liquidation.

GLOBE ELECTRIC CO., LTD.—The liquidator (Mr. W. Osborne) announces a second and final dividend of 1s. 11d. in the £.

AUTOMOBILE ELECTRICAL REPAIRERS, LTD., Euston Road, London, N.W.—A meeting of creditors was held recently at the offices of Messrs. Cole, Dickin & Hills, C.A., Sardinia House, Sardinia Street, Kingsway, W.C. Mr. N. J. Dodd, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs, which showed unsecured liabilities of £815. Of that amount £263 was due to the trade, £44 to the bank, and the balance represented the unsecured amount due to the debenture holders. The claim of the bank amounted to £194, but it held securities valued at £150. The net assets were £160. This was insufficient to meet the claims of the debenture holders, which amounted to £512, and there was no balance available for the ordinary creditors. It was reported that the company was incorporated in January, 1920, with a nominal capital of £1,000. The issued capital was £795. The debentures were in order, and it was pointed out that there was nothing available for the creditors. No resolution was passed, and the voluntary liquidation of the company will therefore be continued by Mr. Dodd. The following are creditors:—

	£		£
Brown Bros.	14	Perra Engineering Co.	59
General Electric Co.	47	Vandervell, C. A., & Co. ...	15
Jeal, W. S., & Ebury Engineering Co., Ltd.	15	Cellins Electrical Co.	32
		Webbs Advertising Agency ...	12

PLANET ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator: Mr. S. H. Swallow, 67, Broad Street Avenue, E.C.2.

HOOTON & ELLESMERE PORT DISTRICT ELECTRIC SUPPLY CO., LTD.—Winding up voluntarily. Liquidator: Mr. S. S. Dawson, 51, North John Street, Liverpool.

BAT METER CO., LTD.—Meeting, February 10th, at 124, Finsbury Pavement House, E.C.2, to hear an account of the winding-up from the liquidator, Mr. J. E. Denney.

Trade Announcements.—The business formerly carried on under the style of GALLWEY, PAUL & BARKER, engineers, contractors, &c., of 40-41, Great Marlborough Street, London, W., has been incorporated as a private company, and will be carried on as Paul & Barker, Ltd., under the personal direction of Messrs. U. G. de Berker and A. G. Spencer, directors.

MR. ASHLEY POPE has commenced business on his own account at Toddington, near Dunstable, where he is acting as agent for the Moorlands Engineering Co., Ltd., of Leek, manufacturers of pumps, &c. He is also agent for various counties for Messrs. Crowther & Osborn, Ltd., manufacturers of the "Sceando" lamps, and is specialising in street, workshop, and shop-lighting fittings.

THE LIVERPOOL ELECTRIC CABLE CO., LTD., has removed its London office from 219, Tottenham Court Road, London, W.1, to 9, Playhouse Yard, Golden Lane, London, E.C.1 (the offices of the London Electric Wire Co. and Smith's, Ltd., with whom it is associated), where large and complete stocks of all ordinary types of rubber insulated cables and flexibles and C.T.S. cables and flexibles will be carried.

Among the new companies registered in Scotland last week was: STANDARD WIRING ELECTRICIANS AND ENGINEERS, merchants, manufacturers, &c., private company. Capital, £1,000 in £1 shares. Office, 37, Bank Street, Kilmarnock.

MESSRS. ROBERT WILSON and JAMES G. DICKSON have commenced business as electrical engineers at 183, High Street, Ayr. Mr. Wilson was for over 26 years manager of the electrical department of Reid & Co., Ayr, and Mr. Dickson was the firm's leading electrician for over 20 years.

MESSRS. TAYLOR, TUNNICLIFF & CO. have acquired a half interest in the patent No. 130,172 granted to Mr. J. A. Colquhoun for electric heating elements, in which the actual heating portion of the conductor is entirely enclosed in fireproof beads, which are raised to a red heat by the passage of a current. A heating element of this type was described and illustrated in our issue of August 20th, 1920.

MR. N. W. PRANGNELL, of 47, Pilgrim Street, Newcastle-upon-Tyne, has been appointed Northern area representative for the following firms:—

Twiss Electric Transmission, Ltd.; London Electric Firm; Electric Street Lighting Apparatus Co.; Venner Time Switches; Berry's Electric, Ltd.; Schofey & Co., Ltd.; Automatic & Electric Furnaces, Ltd.; Chadburn's (Ship) Telegraph Co., Ltd. (land interests); Ewart & Son, Ltd.

MESSRS. S. G. BROWN, LTD., whose works are at Victoria Road, North Acton, W., have lately opened a London depot at 19, Mortimer Street, W., where their electrical specialities and gyro compass may be inspected.

Catalogues and Lists.—THE MACINTOSH CABLE CO., LTD., Rice Lane, Walton, Liverpool.—A catalogue containing numerous illustrations of the firm's cables.

MESSRS. A. P. LUNDBERG & SONS, 477-489, Liverpool Road, N.7.—Leaflet S. 39, illustrating and describing series-parallel tumbler switches. Priced.

THE ENTERPRISE MANUFACTURING CO., Gun Street Electrical Works, E.1.—January price list of electrical accessories and appliances, including lampholders, switches, irons, kettles, fuses, cables, and wires.

MESSRS. E. P. ALLAM & CO., 107-109, Gray's Inn Road, W.C.1.—January stock list of d.c. motors, ranging from 1 to 50 h.p.

MESSRS. JULIUS SAX & CO., LTD., 24a, High Street, New Oxford Street, W.C.2.—A comprehensive catalogue (72 pp.) of electrical accessories, including bells, indicators, relays, bell-pushes, wall plugs, ceiling roses, bowl lighting fittings, Holophane reflectors, &c. Fully priced and illustrated.

THE OVERSEAS ENGINEERING CO., LTD., 68-70, Great Eastern Street, E.C.2.—List No. 195, dealing with "Overseas-National" electric lighting sets; List No. 28, describing "Zenith" and "Overseas-Federal" oil engines; and List No. 54, advertising "Overseas" flour mills. All priced and illustrated.

MESSRS. THOMAS BROADBENT & SONS, LTD., Huddersfield.—An envelope-folder illustrating a number of automatic centrifugal clutches.

THE PRIORY ELECTRICAL ENGINEERING CO., Bath Street, Birmingham.—A catalogue giving illustrations and particulars of "Priory" distribution boards, ceiling fittings, fuses, and cut-outs.

THE RELAY AUTOMATIC TELEPHONE CO., LTD., Marconi House, Strand, W.C.2.—An illustrated booklet containing a concise non-technical description of the "Relay" automatic telephone system.

ELECTRICAL COMPONENTS, LTD., 90, Great Charles Street, Snow Hill, Birmingham.—List No. 93, giving particulars and prices of numerous electrical accessories, including cut-outs, bowl fittings, switches, lampholders, flexibles, &c.

THE STANTON IRONWORKS CO., LTD., near Nottingham.—An illustrated card advertising Stanton-Hume reinforced concrete pipe; also a pamphlet giving dimensions and weights of cast-iron pipes.

MESSRS. L. G. HAWKINS & CO., 116, Charing Cross Road, W.C.2.—An illustrated and priced leaflet dealing with the "Universal" portable electric radiator.

EDMUNDSONS ELECTRICITY CORPORATION, LTD., Broad Sanctuary Chambers, 11, Tothill Street, S.W.1.—"A Practical Suggestion to Farmers," an illustrated booklet giving particulars of small lighting and power plants, with estimates of cost.

HOLOPHANE, LTD., 12, Carteret Street, S.W.1.—A pamphlet illustrating and describing the "Holophane" "daylight" unit for colour matching.

THE BELDAM TYRE CO. (1920), LTD., Windmill Road, Brentford.—A report of tests carried out at the National Physical Laboratory upon "Beldalite" moulded overhead line insulators.

EDISON SWAN ELECTRIC CO., LTD., Ponders End.—Wall show-card of the Royal Ediswan "Fullolite" gasfilled lamp (30 watts and upwards).

Calendars and Almanacs.—MESSRS. W. H. SUGDEN AND CO., of Wakering Road, Barking, have sent us a wall calendar with monthly slips in a red frame. On the back there is a complete calendar for the year.

From MESSRS. C. & T. EARLE, LTD., of Wilmington, Hull, we have received a set of large monthly date sheets for 1922.

The D.P. BATTERY CO., LTD., of Bakewell, Derbyshire, has chosen as the pictorial feature for its 1922 calendar a coloured view of Peveril Castle (a Norman fortress rendered of romantic interest by Scott's novel, "Peveril of the Peak"), in the vicinity of which the D.P. works is situated.

MESSRS. SMITH & CO., of 17, West Tower Street, Carlisle, have issued a wall calendar with monthly sheets for 1922.

MESSRS. STEWART & LLOYDS, LTD., have sent us a set of monthly date cards for 1922 in their usual very neat white and gold desk or wall frame.

MESSRS. FRANK V. COLLINS & CO., of 155, Kingston Road, Wimbledon, S.W.19, have prepared a wall calendar with monthly slips for 1922 below a coloured view giving a "Glimpse of the Summer Sea."

The LEA RECORDER CO., LTD., of 28, Deansgate, Manchester, has sent us a desk calendar block with ample daily spaces for 1922.

The A.C. CUTTING & WELDING CO., LTD., of 25-27, Theobald's Road, London, W.C.1, has issued a calendar for 1922 with monthly sheets, a small memoranda space being left at the bottom.

MESSRS. J. H. WOOLLISCROFT & Co., of New Quay, Liverpool, have issued a wall calendar, consisting of a block of daily slips.

From MESSRS. H. DUNN & SON, of 32, Newington Causeway, London, S.E., we have also received a calendar with daily slips for 1922.

Catalogues Wanted.—Information has been received in the Department of Overseas Trade that the Director of the Public Works Department, Bagdad, Iraq, is anxious to obtain catalogues, designs, specifications, prices, &c., of various machinery and equipment, including electric lighting and power plant, pumping plants, and small electric lighting sets, fans, and accessories.

MESSRS. STEELE, TURNER & WRIGHT, of 333, Argyle Street, Glasgow, who are undertaking electrical mining contracting, wish to receive catalogues and price lists of switchgear, &c., applicable to mining.

For Sale.—The L. & N.W. RLY. Co. has for disposal rotary converting plant, unused, at maker's works, two 150-kW rotary converters, and two 165-kVA 3-phase static transformers.

Burnley Corporation electricity department invites offers for one 250-kW triple expansion Belliss-Dick, Kerr generating set with condensing plant, and one Lancashire boiler, 30 ft. by 8 ft., with superheater and Bennis stoker. (See our advertisement pages to-day.)

Book Notices.—*Electrical Installation Rules and Tables.* Compiled by W. S. Ibbetson, B.Sc., A.M.Inst.E.E. (60 pp.). London: E. & F. N. Spon. Price 1s. 6d.—This vest-pocket reference book contains a wealth of information upon many branches of electrical engineering. The tables include full details of sizes and current-carrying capacities of wires and cables up to 1 sq. in. section; sizes of cables in relation to numbers of lamps of various voltages; currents taken by loads at various voltages; particulars of fuses; intensity of illumination required in certain situations; capacity of conduits; details of motors, such as efficiency, consumption, and cost; and many other useful data.

"The *Textile Recorder* Year Book, 1922" (662 pp.). Manchester: John Heywood, Ltd. Price 7s. 6d. net.—Among the mass of varied information contained in this compendium electricity naturally finds a place, and for this reason the electrical engineer may consider it of value to himself. The application of electric power to textile mill machinery is dealt with in a condensed manner. The characteristics of the various machines, such as their consumption, speed, and nature of running—continuous or intermittent—are touched upon, and advice as to the best type of motor to employ in individual cases is given. For the guidance of the non-electrical mill manager alternating and direct currents are compared, and brief descriptions of several types of motors, indicating their best applications, are included. A brief section is devoted to the consideration of electric lighting, in which suggestions are made as to the correct types of lamps and reflectors to be employed, together with notes on the intensity of illumination required in certain parts of buildings. In the transport section the possibility of the use of electric vehicles appears to have been overlooked. In comparing factory power plant costs the conclusion arrived at is that, owing to the cost of the supply from public sources, generally, the scrapping of up-to-date steam plant in favour of electricity is not profitable. The many advantages of a public supply are, however, set out, and it seems probable that these would counterbalance the apparent extra cost.

"Science Abstracts, A & B." Vol. XXIV, Part 12. No. 288. December 31st, 1921. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"Coalition Government—a League of Parties as an Efficient Method of Government," by O. F. Maclagan. London: Purbrook & Eyres, 96a & 98a, Old Street, E.C. Price 2d.

Crompton's New Power Plant.—MESSRS. CROMPTON & Co., LTD., of Chelmsford, are shortly putting into service a new power station to supply their works in lieu of the existing steam plant. The building contains three 550-h.p. Diesel engines, made by Sulzer, of Switzerland, direct coupled to 375-kW d.c. generators of the firm's own construction.

Electrical Apparatus in Capetown.—The *British and South African Export Gazette* states that the removal of supply restrictions has given an immediate impetus to the local market for fittings, cooking, and heating apparatus, &c. Contrary to the general impression, the bulk of the electrical plant of this type sold in South Africa is of British, and not American, manufacture, and although a certain amount of German competition is being felt, the British article is preferred even if the price is slightly higher. Taking the Union's trade in electrical material and machinery as a whole, it is very significant that, unlike many lines, purchases last year were greatly in excess of those in 1920, the business in cooking and heating apparatus alone being worth £35,692 in the first nine months of 1921, as compared with £28,195 for the same period in 1920.

Capital Reduction.—A petition for confirming the reduction of the capital of P. R. Jackson & Co., Ltd., and Reduced, from £120,000 to £60,000, is to be heard on January 17th.

Factory Sales in 1921.—In the course of a review of the past year's operations in the disposal of factories, wharves, warehouses, land, &c., MESSRS. LEOPOLD FARMER & SONS say that they consider that in spite of the general commercial depression the year's trading was satisfactory, although not up to the standard of 1920. "Prices have not dropped, but activities have been somewhat stationary. . . . Prices depend upon supply and demand and whether a vendor has to realise or not. . . . In the varied negotiations which we have conducted over the year we have not found any panic desire to get out at any price. . . . Fewer new issues of capital for existing and new companies took place, owing to the lack of available ready money, but valuations on this basis have been made by us of buildings, plant, machinery, &c., approximating one and a quarter million pounds. Loans by banks, insurance companies, and investors have not been so readily forthcoming, but in this branch we have been actively employed during the year in valuations, and we should like to see a greater desire by investors to lend on mortgage on factory property, which is an excellent security, and on which a good rate of interest could be obtained. We have conducted a great number of sales of plant and machinery during the year, and, apart from engineering equipment, the prices have been good. At the present time there is a steady demand by established firms, also new concerns, for factory property, and we look forward in the New Year to industrial activity and the disposal of a large number of factories, &c."

Census of Production.—A Board of Trade order has been issued for taking in 1923 a census in respect of the production of the year 1922.

Brazilian Rubber Industry.—According to a *Financial Times* dispatch from Rio de Janeiro, the Brazilian Government, in addition to the recently-voted credit of 25,000 contos (nominally £1,250,000) for the assistance of rubber producers, is engaged upon a scheme to assist the communities of the State of Amazonas, which are badly affected by the rubber crisis.

New South Wales and Trade with Germany.—The Chamber of Manufacturers has been officially informed that trade with Germany will not be resumed until the proposed Tariff Board has been formed and the Anti-Dumping Act is in operation.—*Reuter* (Sydney, January 6th).

The Japanese Commercial Mission.—The Japanese delegates were at Coventry, Birmingham, and Sheffield last week, and among other works visited were those of Messrs. Alfred Herbert, Tangyes, Ltd., W. & T. Avery, Ltd., and the English Electric Co., Ltd. In a speech at a luncheon at Birmingham, Mr. Neville Chamberlain, M.P., said that we recognised that Japan was a great industrial rival so far as the East was concerned, but the East was big enough for both nations. At a conference between the delegates and the Birmingham Chamber of Commerce it was stated that Japan was organising an exhibition similar to our British Industries Fair. The matters discussed included the problem of the international protection of trade-marks and indications of origin.

British Trade Mark Applications.—Appended is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries:—

Quixup. No. 419,372. Class 13. Electric cooking utensils. General Electric Co., Ltd., Magnet House, Kingsway, London, W.C. October 8th, 1921.

Silca. No. 420,245. Class 13. Sparking plugs for internal-combustion engines. Philip Challis, 30, Carlisle Mansions, Victoria, London, S.W. November 5th, 1921.

H.E.E.M.A.F. (lettering and design). No. 418,373. Class 6. Electrical machinery and parts of same. Hengelsche Elektrische en Mechanische Apparaten Fabriek, 5, Bornschestraat, Hengelo (O), Holland. September 2nd, 1921.

Callender Cable (lettering and design). No. 419,340. Class 8. Electric cables. Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. October 7th, 1921.

F.M. 100 per cent. (lettering and design). No. 413,048. Class 6. Dynamos and motors, &c. Fairbanks, Morse & Co., 900, South Wabash Avenue, Chicago. March 3rd, 1921.

R.O.A. (lettering and design). No. 418,775. Class 8. Thermionic valves. The Mullard Radio Valve Co., Ltd., 35a, Claybrook Road, Hammersmith, London, W. September 22nd, 1921.

CORRECTION.—In the ELECTRICAL REVIEW for September 23rd, 1921, page 407, two errors occurred in the list of applications by the Osram Co., of Berlin, for certain British trade marks. The third item in the list there given should read "Osa," not "O.A.," and the eighth item should be "Durosa," not "Dursoa."

Unemployment.—An increase in the number of unemployed persons was shown in the Ministry of Labour returns on December 30th. The total was 1,885,300, as against 1,813,710 a week earlier. The number of workers on short time on December 22nd was 270,747, a decrease of about 5,000 in the week.

Electric Vehicles in Germany.—The Deutsche Elektromobil und Motoren Werke Gesellschaft is the name of a new undertaking which has lately been formed at 35, Konigstrasse, Hanover, with a capital of 1,000,000 marks, to construct electric motor vehicles, motors, &c.

Patent Restoration.—An order has been made restoring patent No. 11,387, of 1912, for "Improvements in rotary pumps or motors," granted to Frank Reaugh.

Patent Revocations.—An order was made on January 3rd, 1922, revoking the undermentioned letters patent:—No. 5,545, of 1912, for "Process of manufacturing negative electrodes for alkaline accumulators"; No. 72, of 1914, for "Process for restoring the activity of a positive electrode mass for alkaline accumulators"; and No. 123, of 1914, for "Improvements relating to electric accumulator cells," all granted to Svenska Ackumulator, Aktiebolaget Jungner.

New French Companies.—*Société d'Energie Electrique de le Côte Roannaise* is now the style of the firm of Vallas-Loisel, converted into a *société anonyme* with capital of 252,000 fr. Its objects are the installation of electric generating stations and offices at St. Just-en-Chevalet (Loire).

There has been formed at Paris (29, Rue de la Voûte) the *Société d'Installations et de Montages d'Usines*, with a capital of 100,000 fr. Its objects are the building and equipment of generating works.

The acquisition and development of waterfalls in general is the scope of the *Hydroélectrique du Doubs*, a company just constituted at Paris (94, Rue St. Lazare), with a capital of 100,000 fr.

New Italian Companies.—There has been formed at Turin the *Consorzio Impianti Trazione Elettrica*, with a capital of 1,000,000 lire, of which 300,000 lire is paid up.

A trust company has been constituted at Turin embracing the *Società Fiat*, the *Società Officine di Saviglione*, and the *Società Idroelettrica Piemonte*, with the object of electrifying railway and tramway lines.

With a capital of 300,000 lire has been embodied at Milan the *Società Anonima Impresa Elettrica Pollentina*.

Idroelettrica Cuneo Fossanese is the style of a company formed at Cuneo, with a capital of 300,000 lire, for the generation and distribution of electric energy.

Under the style of *Società Anonima Idroelettrica del Porara* a company has been established at Perticeno di Sassoferrato.

Sequestration.—The estates of R. Anderson Wilson, mechanical and electrical engineer, 19, Waterloo Street, Glasgow, were sequestrated on January 4th, 1922, by the Sheriff of the County of Lanark at Glasgow. Meeting of creditors, January 16th, at Faculty Hall, St. George's Place, Glasgow. Particulars of claims by May 4th to Fergusson & Ross, agents, 30, Renfield Street, Glasgow.

Socials.—The second annual Christmas party of the Halifax Corporation tramway employés' children took place on January 3rd at the Tramways Club.

The British Empire Exhibition.—The work upon this exhibition was inaugurated on January 10th by the Duke of York, who cut the first sod of the site at Wembley Park.

The Port of Swansea.—The Swansea Harbour Trust has issued an official handbook for the current year, under the title "The Port of Swansea." For the information of manufacturers, shippers, and others, the general manager, Mr. P. W. Phillips, refers to the industrial facilities offered by the port, its harbours, its docks, the 500 works and collieries within a radius of 20 miles, harbour and dock rates and charges, and the merits of Swansea as a distributing centre for South Wales. There are large areas of available land suitable for the erection of large works and industries.

Electrical Wages in Cape Town.—The agreement between the Electrical Contractors' Association and the Electrical Trades Union, with regard to wages, expired on December 31st. The Association has made an offer to the Union to pay 2s. 6d. per hour to competent men, but the Union considers that the men should have the same rate of pay as men in the building trades, viz., 3s. 2d. per hour until March 31st, when a further agreement will be come to.

Czecho-Slovakian Glassware, &c.—A showroom has been recently opened at 114, New Oxford Street, W.C.1, by Messrs. RICHSON & CO. At these premises numerous lighting fittings, manufactured at Steinschönau, Czecho-Slovakia, are displayed. Crystal chandeliers form some of the principal exhibits, and all these are extremely ornate and of excellent workmanship. Various types of glassware bowls are shown, these including many-coloured mosaics, either leaded together or held by a special compound. Many beautiful designs executed in mother-of-pearl and shells are also on view. Another feature is a range of lanterns decorated with 18th-century silhouettes. Many of the bowls and lanterns are coloured by means of a special material known as "Batik," which is held between two pieces of glass.

A Conundrum.—Readers of our advertisement pages will find there a cryptic numerical announcement on which they may exercise their ingenuity. We don't know the solution, but we are assured that one will be forthcoming by and by. Unfortunately there is no indication that a prize will be awarded to the successful solver!

British Trade and the German Indemnity.—Speaking on "The Economic Effect of the German Indemnity" at a meeting of the 1912 Club, held in the City of London, Mr. Herbert G. Williams, M.Sc., A.M.I.C.E., the secretary of the Machine Tool Trades Association and prospective Conservative candidate for the Wednesbury division, said he thought the Germans ought to pay an indemnity, and that they could pay an indemnity. He also thought that the views held as to the size of the indemnity at the time of the last General Election were very much exaggerated. He remembered a suggestion that with coal alone the Germans could pay for the war several times over. The process of calculation was to take the total tonnages in the mines of Germany and multiply them by what their value would be when raised to the surface, and then say the coal-mines were worth that amount. Of course they were worth nothing like that sum. Nine-tenths of the value of coal, when raised to the surface, represented human effort in one form and another. The total value of the coal before it was raised was, he supposed, twenty times the amount of the royalties which would be obtained in a year from the German coalfield. Some people had suggested that the German coal-mines were worth, he thought, a hundred thousand millions of pounds, whereas he was quite satisfied that the royalty owners of Germany would have been prepared to take £300,000,000 or £400,000,000, cash down, with the greatest pleasure. That illustrated the absurd kind of exaggeration that had taken place. The maximum of indemnity a country could pay was represented by the excess of its exports and value of services it rendered to other people over and above its imports and the value of the services it received from other people. What was the effect on the balance of trade if Germany had to pay an indemnity, or, what was the same thing, if we had to repay to the United States the money we had borrowed and interest upon it in the meantime? If Germany was to pay the indemnity, she had got to buy less relatively from us and everybody else and sell more to us. If we were going to have the indemnity, what steps were we going to take to see that the competition was of the right kind, and did not do us more harm than good? Germany's capacity at the moment to pay a large indemnity was obviously small, if not in fact negligible, and the payments she was making were made by selling for good money the paper which might become utterly worthless. Germany's exports at present were far less than in pre-war times; her competition was not yet a factor in the world. That the Germans in the long run would have to tax themselves was self-evident, but that was their business, and not ours. We had no power to regulate the German system of taxation. Our national taxation equalled £20 per head, apart from local expenditure. German taxation some months ago, if we took the external value of the mark, was £3 per head, and if we took the internal value of the mark it was £7 per head. Germany produced practically every kind of article that we could produce, and other things as well. Without some regulation this country would be flooded with competitive German goods at prices below those at which we could produce. We had passed a peddling Act of Parliament called the Safeguarding of Industries Act, but he did not think this Act was adequate to secure the necessary regulation of German competition. He urged that the United Kingdom must select the form in which the indemnity was to be paid, and that the best way was by tariffs on competitive goods to counteract exchange bounty. This would raise the price of those goods, but lower the price and increase the volume of non-competitive German goods. The Germans would produce more than they were allowed to consume, while we should consume more than we produced. The German standard of living would be reduced; ours would be raised. There was a limit to the period in which an indemnity could be collected. Ultimately the penalised country would fight rather than pay. He did not know what the limit was, but he doubted, taking two countries of equal strength, whether one could go on collecting an indemnity for more than twenty or twenty-five years. He thought the indemnity ought to increase by gradual steps until it reached its maximum annual amount in the middle year, which, if for a period of twenty-five years, would be at the end of the twelfth year, and then diminish by gradual steps until it was paid. Let us be careful, when some of us were privileged through the indemnity to consume more than we had produced, that we did not as a result deprive some of our fellow citizens of the chance of consuming anything at all because they were prevented from producing anything.

Cost of Living in Germany.—According to calculations made by the Statistischer Reichsamt, based on the cost of food, heating, lighting, and lodging at the middle of the month, the index figure for the cost of living rose from 1397 in November to 1550 in December, or 11 per cent. The increase compared with December, 1920, amounts to 66 per cent.—*Reuter's Trade Service* (Berlin, January 6th).

Fuel from Waste Material.—The *Industrial Daily News* states that a large new works is to be erected near Nottingham for the purpose of carrying out a new process of low-temperature carbonisation upon "smudge"—waste material from the Midland collieries. It is proposed to produce gas and oil, as well as briquettes for fuel, and other by-products. A company has been formed with the title of Midland Coal Products, Ltd., and several large oil and colliery firms are represented in its constitution.

A Hire-Purchase Credit System.—A scheme which we believe to be new to the electrical contracting industry of this country has been introduced by MESSRS. L. G. HAWKINS & Co., 116, Charing Cross Road, W.C.2, to enable dealers in the larger "Universal" appliances to dispose of these on a hire-purchase system without incurring a large outlay themselves. Briefly the scheme is as follows:—Arrangements have been made with a financial trust company whereby all dealers who can submit satisfactory credit references will be able to finance, without drawing on their own capital, their sales of "Universal" electrical clothes washers, ranges, and vacuum cleaners, with deferred payments running over a period of twelve months. Full particulars are embodied in a folder issued by Messrs. Hawkins.

Electrical Exhibition at Christiania.—The exhibition devoted to the "Utilisation of Electric Power" to be held at Christiania, from April 22nd to May 7th, will be open to foreign as well as Norwegian exhibits. Further details may be obtained from the Exhibition Section of the Federation of British Industries.

An Electrical Carnival.—MR. E. BRONTMAN, of Parkstone, Dorset, who recently organised an electrical exhibition at Bournemouth, is arranging a novel carnival to take place shortly. This will be a procession of horse-drawn carts each carrying a huge model of an electrical appliance, such as an iron, a washing machine, or a cooker. It is proposed to copy actual examples of the products of firms participating in the scheme.

Capital Increases in Germany.—According to statistics issued from reliable quarters, 86 electrical and gas companies in Germany made nominal increases in their share capital of a total amount of 1,995.50 millions of marks in 1921, as compared with 84 and 1,004 millions in 1920. Loans bearing a fixed rate of interest were offered by 31 gas and electrical companies for 2,368.4 millions as against 30 and 476 millions respectively in 1920. In addition, 52 new electrical and gas companies were formed in 1921 with a total nominal capital of 1,709 millions, contrasting with 15 companies and 79.9 millions of marks in the previous year. A large portion of the capital invested in new companies applies to the electricity industry, the share capital of the South German hydro-electric works alone representing 1,625 millions of the total of 1,709 millions given under this heading.

German Works in China.—It is reported that, in conjunction with several Chinese firms, the Siemens & Halske Co. has formed a Chinese company at Shanghai, where a works has been established for the production of electrical manufactures corresponding to the requirements of the Chinese market. The new company has taken over the whole of the German company's organisation in China and undertaken to dispose of the products of the Rhine-Elbe-Union. It is proposed to organise branches of the company at Soochow and Wasik.

Large Electric Steel Furnace.—We learn that the Ford Motor Co. has placed an order for "Greaves-Etchells" electric furnaces with the Electric Furnace Construction Co. (the American branch of T. H. Watson & Co., of Sheffield, Ltd.), including the largest electric steel-melting furnace ever designed. Its capacity will be 9,000 kVA and over 60 tons of steel, being fitted with six electrodes. Two "Greaves-Etchells" electric furnaces are already operating at the Ford works at Detroit, and, in addition to the large furnace mentioned above, two 10-ton "Greaves-Etchells" furnaces are on order. The large furnace will be the principal melting unit of the new battery of electric furnaces for the Ford Co.'s River Rouge Works.

An Edinburgh Housing Exhibition.—An Ideal Homes and Housing and Health Exhibition is to be held in the Waverley Market, Edinburgh, in February. No doubt electrical traders will be well represented in view of the popularity of electricity in the Corporation and other housing schemes.

The British Industries Fair.—Work has been commenced upon the London section of the Fair at the White City. The invitations sent to overseas firms and individuals have met with an excellent response, and it is anticipated that the number of visitors to the Fair will greatly exceed the attendance in previous years.

LIGHTING AND POWER NOTES.

Australia.—TASMANIA.—The annual report upon the State hydro-electric undertaking for the year 1920-21 has recently been published. A large increase in production and augmented profits are shown.

LISMORE, N.S.W.—The Municipal Council has adopted an electricity supply scheme for the town. Two 150-kW steam-driven sets will be installed, and the estimated expenditure is £32,153. The scheme is to be proceeded with forthwith.

Birkenhead.—LOANS.—The Electricity Committee is applying for sanction to borrow sums amounting to £6,927 for the provision of high-pressure plant and mains.

Blackburn.—LINKING-UP STATIONS.—Important decisions were confirmed by the Town Council on January 5th, as the result of a joint meeting between the Preston and Blackburn Electricity Committees. It was decided that the new Blackburn station at Whitebirk should be connected with the proposed station at Preston by a duplicate main at an estimated cost of £138,000, such expenditure to be borne equally by the Blackburn and Preston authorities, and that arrangements be made for supplying customers *en route*. Mr. J. Robertson, electrical engineer of Salford, is to prepare a scheme for the supply of the district, and his expenses are to be shared equally between the two authorities. Blackburn and Accrington Councils are also contemplating a similar joint communication, so that the whole of the district from Accrington to Preston will thus be linked up.

Bradford.—LOANS.—The Council is applying to the Electricity Commissioners for sanction to raise loans to cover excess expenditure on schemes previously approved by the City Council as follows: (a) No. 5 turbo-generator, &c., excess incurred or to be incurred, £19,835; (b) coal handling plant, excess, £10,540; (c) No. 6 turbo-generator, &c., excess, £43,139.

EXTENSIONS.—The Electricity Committee has asked the City Council to sanction further capital expenditure upon extensions of electricity mains, &c., up to a total of £20,000. The recommendation has been approved by the Finance Advisory and Co-ordination Committee.

EXTENSION OF SUPPLY.—The Electricity Committee has instructed the Town Clerk to apply to the Electricity Commissioners for a special Order enabling the Corporation to supply electricity in the district of Clayton; and, pending the obtaining of such order, for "Fringe" Orders to supply premises in that district in cases in which applications for electricity may be received.

Bognor.—PRICE REDUCTIONS.—The Electric Supply Co. has adopted the following revised prices: First 50 units per quarter, 1s. per unit; second 50 units per quarter, 11d. per unit; beyond, 10d. The heating rate is now the same as the power rate, viz., 6d. first 100 units, and 4d. beyond this.

Burnley.—LOANS.—The Electricity Committee recommends applications for sanction to borrow the sum of £5,000 for electricity services, and £20,000 for electricity mains, the loans to be for as long a period as the Commissioners will allow.

Burton-on-Trent.—LOAN.—The Electricity Committee recommends application to the Electricity Commissioners for sanction to borrow £20,000 for the extension of the electricity undertaking.

Caerphilly.—ELECTRIC LIGHTING SCHEME.—Reporting on the progress of the Council's electric lighting scheme, Mr. D. T. Salathiel, J.P., stated on January 3rd that all the difficulties had been surmounted, and it was hoped that the installation of the system would be commenced within two months.

China.—DAIREN.—Some interesting figures relating to Dairen's electricity supply in 1920 are published by the *Manchuria Daily News*. The total supply capacity of the South Manchuria Railway Co.'s electric power house, Dairen, is given as 4,875 kilowatts. The aggregate amount generated during 1920 was 14,074,770 kWh, returning 1,632,598 yen in receipts, against an outlay of 977,918 yen.—*Reuter's Trade Service* (Shanghai).

Continental.—SWEDEN.—The main transmission line between the hydro-electric works at Trollhätten and Vasteras has now been brought into use. It serves for transmission to East Gothland and the Nalare province, and has involved an expenditure of 10,000,000 kronen; the pressure is 220,000 volts, and it will be possible to increase the present supply of 35,000 kW to about 100,000 kW. It is considered that the line will form a link in the great transmission system from Norrland to the most southern part of Skane.

ITALY.—Among the works which have been seriously affected by the shortage of power consequent upon the long drought is the Fiat motor works, Turin, which has electrically-driven machinery throughout, as well as electric furnaces. The difficulty has been overcome by the use of 25-35 h.p. agricultural tractors, of which there are now about 150 in use. In normal times the company's production of hydro-electric power is more than sufficient for its needs, and supplies are given to the municipality and to other manufacturers.

RUSSIA.—It is reported that considerable extensions are to be made to the port of Petrograd. Harbours, docks, and wharves are to be improved, and the whole port area is to be lighted electrically.

Crediton.—SUPPLY FROM EXETER.—The Urban Council recently received from Exeter Town Council an intimation to the effect that it could not at present extend the area of supply so as to include Crediton, but it was prepared to give a bulk supply at the City boundary. The Council has referred the matter to the General Purposes Committee for consideration.

Dewsbury.—LOAN SANCTIONED.—Sanction has been received from the Electricity Commissioners to borrow £6,000 for the laying of cables in Ravensthorpe district, and from the electricity works to Staincliffe Road.

Derby.—PRICE REDUCTION NOT POSSIBLE.—In reply to suggestions of a decrease in electricity charges, the chairman of the Electricity Committee recently stated that the cost of fuel made a reduction impracticable. During the miners' dispute the Committee had had to pay four times the normal price for fuel.

Douglas (I.O.M.).—ELECTRICITY BILL APPROVED.—The Bill promoted by the Douglas Corporation before Tynwald last summer to provide an electricity supply for the district has received the Royal Assent, and Messrs. Handcock and Dykes have been instructed to prepare the necessary plans and specifications for the work. It is hoped to have the station running by about May, 1923.

Glasgow.—LIGHTING MUNICIPAL OFFICES.—Although it was stated that it was desirable to light by gas the new portion of the municipal offices which is to be occupied by the Gas Department, the Council has decided to install electric lighting.

Haverfordwest. — PROPOSED ELECTRICITY SCHEME. — The Town Council at its last meeting discussed a scheme for lighting the town with electricity. Under the proposals the Council would have the option of purchasing the system at the expiration of twenty years. Negotiations in connection with the matter are still proceeding.

Hereford.—NEW SUPPLY COMPANY.—In a report to the Council the Electricity Committee explains that Mr. Kerr, acting under the instructions of the Committee, as authorised by the Council at its meeting in March last, has been engaged in negotiating the sale of the Corporation's surplus power in the Forest of Dean. Early in the negotiations it became plain that the demands for power in that area were greatly in excess of the capacity of the Corporation's present plant, and also that the only way in which a supply could be given, either from the Corporation's Lydbrook line or otherwise, was by forming a company to provide the capital and carry out the necessary work. This Mr. Kerr has succeeded in doing, and he leaves to take up a position with this company. The new company desires to obtain at once as much energy as the Corporation has available on terms to be agreed. The committee asks the authority of the Council to negotiate an agreement with the company for a supply of energy from the Lydbrook line.

Ilford.—PRICE REDUCTIONS.—The Council has sanctioned a new scale of charges which involves a reduction in the price of electricity for lighting, power, and vehicle charging.

Japan.—POWER DEVELOPMENT.—Important schemes are in progress for the development of the abundant water-power of Japan. In 1920 a company named the Daido Electric Power Co. was formed to absorb three existing companies and to supply power to the districts of Nagoya, Osaka, and Kobe, the capital involved being 100,000,000 yen (about 12 millions sterling). Three other concerns are erecting power stations in the same district—the mountainous region to the north of Nagoya; two of them will transmit energy to Osaka, and the other two to Tokio, the line pressure in each case being 154,000 volts. The Daido company has three stations in operation, aggregating 38,600 kVA, and three more in course of erection, aggregating 135,000 kVA; another station of 100,000 kVA is projected. The total length of the 154,000-volt lines is 199 miles, and they are expected to be put in operation next summer. Most of the plant is of Westinghouse design and manufacture.

Kendal.—ELECTRICITY SUPPLY.—In a letter to the Corporation the Electricity Commissioners state that they have had under consideration the letter regarding the position of the electricity undertaking at Kendal and the possibility of a bulk supply being obtained under the scheme which has been submitted in respect of the district by the Provisional Joint Committee. In this connection the Commissioners note that the scheme provides for the construction of a transmission main to Kendal. Having regard to the procedure laid down in the Electricity (Supply) Act, 1919, and to the time that must necessarily elapse before any scheme which might be approved by the Commissioners could become of statutory effect and be put into operation, the Commissioners are unable to advise the Corporation to defer consideration of any action that may be required to enable the Corporation to carry out its statutory obligations under its Electric Supply Order of 1900.

Leeds.—PRICE REDUCTION.—The City Council, on January 4th, by a large majority, adopted a recommendation of the Electricity Committee that the price of electricity be reduced by 30 per cent. to power consumers, and by 10 per cent. to domestic users. The object of the committee, it was stated, was to help industrial concerns in bringing about a revival of trade, and therefore more general prosperity.

Littlehampton.—COMPANY'S OFFER ACCEPTED.—The Urban District Council has decided, subject to a satisfactory agreement being entered into, to accept an offer by the Sussex Electricity Supply Co., Ltd., to install an electric lighting system by overhead wires in the urban district, and to support an application to the Electricity Commissioners to that effect. The chief conditions suggested are that steel standards of an approved design be used for carrying the wires in the principal thoroughfares; that the company shall be given an opportunity to tender for the public lighting; and that the Council shall have an option of acquiring the undertaking in the future, if desired, on agreed terms. It was stated in the course of discussion that the company would be prepared to provide the necessary capital, roughly estimated at about £20,000, and to proceed with the work of installing a supply at once; that the supply would be at 225 V d.c.; and that the prices would range from 1s. to 9d. per unit for lighting, and from 9d. to 6½d. per unit for heating and power purposes.

Liverpool.—LOANS SANCTIONED.—The Electricity Commissioners have sanctioned the borrowing of the sum of £21,782 for the provision of mains and services and a sub-station building and equipment in connection with the supply of electricity to the housing scheme at the Springwood Estate, and £100,000 for the provision of electric mains.

ACQUISITION OF BOOTLE UNDERTAKING.—As was recently indicated in our pages, the transfer of the Bootle electricity works to the Liverpool Corporation has materialised. The agreement which has been reached between the two corporations shows that the transfer will be effected on April 1st, and will come into full operation on July 1st. Subject to this Liverpool is to take over the whole assets of the Bootle undertaking, and to pay the Bootle Corporation the sum of £7,500 per annum in perpetuity. As the Liverpool Corporation runs electric tramcars through Bootle, difficulties with regard to the maintenance of overhead equipments will be removed. The Bootle undertaking last year made a profit of £6,343, and Mr. Dickinson, the Liverpool electrical engineer, estimates that next year the profit should be £10,000.

LIVERPOOL LIGHTING CO.'S UNDERTAKING.—It has also been decided to acquire the undertaking of the Liverpool District Lighting Co., Ltd., for £4,000 per annum, with the right to commute, either by the payment of £60,000 cash or by the issue of mortgages to produce £3,600 per year. This undertaking supplies the districts of Waterloo and Great Crosby, and last year the output was 650,000 units.

London.—ST. PANCRAS.—The total income of the electricity undertaking for the year ended March 31st, 1921, amounted to £90,989, and working expenditure to £68,888. Of the surplus of £22,101 capital charges absorbed £18,116, leaving a net profit of £3,985 which was transferred to the reserve and renewals account.

SALE OF STATION.—The Davies Street generating station of the Westminster Electric Supply Corporation was recently sold by private treaty. When the machinery has been removed the buiding will be reconstructed and made into flats.

PRICE REDUCTIONS.—The Westminster Electric Supply Corporation, Ltd., has notified its consumers that the following reduced prices will be put into force as from the December meter readings: Lighting, first 1,000 units, 7½d. per unit; next 3,000, 7d.; above 4,000, 5½d. per unit. Power, heating and cooking, 1½d. per unit.

Maidstone.—LOANS.—The Town Council has applied for loans of £3,300 for two 1,000-kVA transformers; £1,250 for mains, switchgear, and a transformer; and £700 for mains, switchgear, &c., for an increased supply to the Medway Milling Co.

Pembroke.—WATER-POWER.—Sir Frederick Meyrick presided at Pembroke on January 4th at a largely-attended conference representative of the local bodies and of influential people in the country called to discuss the proposed introduction of new industries into the borough in view of the Government's decision to practically abolish the dockyard. The town clerk stated that among the Council's suggestions was the starting of a cement works. Other suggestions were a patent fuel works, the manufacturing of baskets and chairs, the establishment of steam-driven laundries, and finally Sir Frederick Meyrick's suggestion was that they should develop electrical power by means of a barrage. Alderman E. B. Harries remarked that a cheap supply of electricity would attract industries. He suggested that they should find out what it would cost to secure a plentiful supply of electrical power. He thought the barrage scheme could be put through in about twelve or eighteen months. Sir Evan Jones, M.P., opposed the barrage scheme, and described the details of a similar scheme known to him which was estimated to cost a million and a half pounds, and the working costs of which were exactly double the costs of bringing coal down to the district at 30s. per ton and generating electricity. Further consideration is to be given to the schemes propounded.

Peterborough.—LOAN SANCTIONED.—Having received the sanction of the Electricity Commissioners to the borrowing of money for the extensions in connection with the electricity undertaking, the City Council has decided to proceed with the work forthwith.

Preston.—SPECIAL ORDER.—The Town Council has applied for a special order authorising it to supply electricity within the borough, the urban district of Fulwood, and the parishes of Broughton, Lea, Ashton, Ingol, Cottam, Woodplumpton, Barton, and Penwortham, in the Rural District of Preston; and to acquire and use for the purpose of a generating station land in the township of Penwortham.

Rochdale.—PROPOSED SUPPLY FOR NORDEN.—The Electricity Committee recently received a letter from the Urban District Council of Norden, stating that it had decided to apply for a Special Order to supply electricity within its area. The Committee asked the Bulk Supply Sectional Committee to carry out the necessary negotiations for furnishing a bulk supply to Norden if the application to the Electricity Commissioners was successful.

Rotherham.—PROPOSED PRICE REDUCTIONS.—The Electricity Committee recommends that the price of electrical energy for power and heating purposes be reduced from 150 per cent. to 100 per cent. on pre-war rates, and for lighting purposes from 75 per cent. to 62½ per cent. on pre-war rates.

Sennybridge (Brecon).—WATER-POWER SCHEME.—A small company was recently floated, and nearly all the business premises, as well as many private residences, are being illuminated by electricity produced by means of an old water wheel.

South Africa.—STRIKE AT JOHANNESBURG.—*Reuter* messages state that the South African Industrial Federation declared a strike, commencing on January 9th. The Federation embraces the whole of the gold and coal miners of the district. It is reported that the Premier visited Johannesburg on January 7th and asked the executive of the Federation to permit the supply of coal to power stations, but this was refused. It is stated, however, that hospital lighting and the essential municipal services will be maintained.

It was authoritatively stated that the coal supplies of the Victoria Falls Power Co. would be exhausted on January 6th, and all industries dependent on these supplies would be stopped. It was understood that if the power supply was cut off from the mines on the Reef for a considerable period it would be necessary to repatriate the natives on the ground of expense, and possibly in the interest of public order.

Spalding.—PROPOSED ELECTRICITY SUPPLY.—The Urban Council has circularised possible users of electricity in the town with a view to ascertaining the number of likely consumers. A covering letter intimates that the probable price of electricity will be 10d. per unit

St. Annes.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for sanction to borrow £31,000 for electricity purposes.

Stone (Staffs.).—ELECTRICITY SUPPLY SUGGESTED.—Complaints were made at a meeting of the Urban Council about the unsatisfactory gas supply, and it was suggested that an electricity plant should be installed, which could be run from the sewage works at little expense.

Swansea.—LOAN.—Reporting to the Electricity Committee on December 4th, the borough electrical engineer (Mr. J. W. Burr) stated that the cost of the extension to the Mumbles would be £14,000. The sum approved by the Electricity Commissioners for mains extensions was about exhausted, and he asked for sanction to secure another £20,000, which would suffice for the next three years. This was agreed to.

Torquay.—PROPOSED PURCHASE OF UNDERTAKING.—The Town Council has decided to apply for power to enable it to carry out the terms of a draft agreement whereby it is proposed to purchase and work the Newton Abbot undertaking of the Urban Electric Supply Co.

Wallasey.—LOAN.—The Electricity Committee is applying for a loan of £10,000 for electricity purposes.

Walsall.—MAINS EXTENSIONS.—The Electricity Committee recommends extensions of mains at a cost of £1,570, including the provision of an a.c. main from the L. & N. W. Railway Co.'s sub-station in Corporation Street to premises in Midland Road.

Watford.—LOAN, &C.—A loan of £3,500, balance required over a previous loan of £45,300, for mains extensions has been applied for. The Town Council has reduced the charge of electricity for the quarter ending March next by 10 per cent. making the increase over pre-war rates 70 per cent.

Weybridge.—LETTER FROM COMMISSIONERS.—The Electricity Commissioners have written to the Council in reply to a protest against the increased prices allowed by the Commissioners to be charged by the Urban E.S. Co. They state that the evidence put forward at the recent inquiry satisfied them as to the justice of the increase.

Winchester.—PRICE REDUCTION.—The Town Council has reduced the price of electricity by 15 per cent., as from the September quarter meter readings.

Worcester.—LIGHTING NEW HOUSES.—At a meeting of the City Council, on December 3rd, the report of the Housing Committee embodying a resolution against the provision of mains for supplying electric light to the new houses in the Bromyard Road was discussed, and a resolution that the Committee be instructed to provide electric mains was carried. The total cost of providing the mains will be £380.

LOAN SANCTIONED.—The Electricity Commissioners have approved of the Electricity Committee's application for a loan for capital expenditure.

TRAMWAY AND RAILWAY NOTES.

Bradford.—LOAN.—The Tramways Committee recommends application to the Ministry of Transport for power to borrow £86,792 for track reconstruction work during 1922, as follows: Barkerend Road (Byron Street to Rushton Road), £23,910; Forster Square, £28,911; Little Horton (Holme Top Lane to Southfield Lane), £28,839; and Manchester Road (Bentley Fold to Pearson Fold), £10,132.

SLEEPER-TRACK CONSTRUCTION.—The Tramways Committee has approved a proposal of the City Engineer for the use of sleeper track construction on a portion of the Wyke section in Huddersfield Road, extending from Odsal Top to Salisbury Road.

Brighouse.—CONTROL OF SYSTEM.—On January 6th, Halifax Corporation entered on a further seven years' term of sole control of the Brighouse tramway system. Brighouse and Hipperholme were willing to buy this portion of the system, and Bradford Corporation had expressed willingness to take it over, either by purchase or lease, with a view to reconstruction of the Brighouse-Bailiff section to suit the Bradford track gauge, but Halifax is only willing to sell the whole of its lines and equipment in the two townships affected, or none at all, declining to sell the Bailiff section separately. Under the Tramway Act compulsory purchase powers may be applied only to the whole of the system.

Coatbridge.—SALE OF SYSTEM.—The transfer of the Airdrie and Coatbridge tramway system to the Glasgow Corporation has been agreed to by the Coatbridge and Airdrie Town Councils. The purchase price is £82,250.

Continental.—FRANCE.—Increased tramway and omnibus fares are to come into operation in Paris on January 22nd.—*The Times.*

SPAIN.—The *Railway Gazette* reports that the second section of the Madrid Metropolitan Underground Railway was opened on December 26th in the presence of the King and Queen. The new section has been constructed between the Puerta del Sol and the Madrid, Zaragosa, and Alicante station at Atocha, and it is expected that the extension to Vallecas will be opened early in the spring.

Doncaster.—INQUIRY.—A Ministry of Transport inquiry is to be held on January 31st into the Corporation's proposal to make a loop by laying a tramway track along Trafford Street and Factory Lane to the existing terminus in Station Road. At the September meeting of the Council, when the matter was introduced, there was some opposition.

Halifax.—A WARNING ANEMOMETER.—Consequent upon the blowing over of two tramcars, last winter, at Catherine Slack, on the Queensbury route, and the necessity for the remainder of the winter to withdraw all upper-deck cars from that route, the Tramways Department has had an anemometer fitted at Catherine Slack, registering wind velocity between 20 and 40 miles per hour. When the latter is reached a warning bell is rung at the tramway depot, and only single-deck cars are allowed on the route.

Japan.—RAILWAY ELECTRIFICATION.—The *Board of Trade Journal* quotes the *Yokohama Chamber of Commerce Journal*, as stating that, following the formation of definite plans for the electrification of Japanese railways by the Electrification Investigation Commission, it has been decided to electrify a number of sections of line with an aggregate length of 2,000 miles. On a number of routes hydro-electric energy will be available.

Leyton.—SUPPLY TO L.C.C. TRAMWAYS.—The Council has applied for sanction to borrow £34,454 for the purpose of arranging a supply of electricity to the L.C.C. tramways. A sub-station will be erected in the district.

Liverpool.—ACCIDENT.—A number of people were injured in a collision at Liverpool on January 4th between an electric tramcar and a motor wagon, three persons being removed to hospital.—*The Times.*

London.—NIGHT SERVICES.—The L.C.C. has received petitions from numbers of night workers living in the suburban area requesting improved night services on the Brixton and Tooting routes.

THROUGH SERVICE TO WIMBLEDON.—The L.C.C. is negotiating with the London United Tramways, Ltd., regarding a through tramway service from London to Wimbledon.—*The Times*

NEWLY-ELECTRIFIED LINE.—It is stated that trial runs will be made shortly over the recently electrified portion of the L. & N.W. Railway Co.'s line between Queen's Park and Euston.

The *Daily Mail* states that the L. & N.W. Railway Co. contemplates electrifying the North London line between Broad Street and Poplar.

South Africa.—CAMPS BAY.—The Camps Bay Tramway Co. has notified the Cape Town Council that it is prepared to consider the question of taking a supply in bulk from the Corporation. The Electricity Committee of the Corporation has authorised the city electrical engineer to negotiate with the Tramway Co. regarding the proposed supply.

TELEGRAPH AND TELEPHONE NOTES.

Belgian Congo.—NEW WIRELESS STATION.—The Belgian Government has decided to construct at the town of Elisabethville, in the Belgian Congo, a wireless telegraph station of great power, with a view to direct communication between Belgium and the Congo, says *The Times*.

Czecho-Slovakia.—WIRELESS TELEGRAPHY.—A wireless station of from 50 to 100-kW capcity is in course of erection at Podebrad. It is intended for communication with Central European stations and overseas. For inland communications smaller stations will be set up at Podebrad, Brunn, and Kosice, besides stations for flying purposes. The installation of a wireless station at Bratislawa, to secure the safety of the shipping of the Danube, is also under consideration. When the financial situation has become better it is likewise intended to equip the offices of big departmental heads as well as some industrial districts with small wireless plants in order to complete the inland network.

Dutch Guiana.—TELEGRAPH SERVICE.—In the course of a written answer to questions raised in the First Chamber of the Dutch States-General concerning telegraphic communication with Surinam, Dutch Guiana, the Minister for the Colonies states that the Governor of Surinam granted a concession to the Compagnie Francaise des Cables Télégraphiques on September 18th, 1889, for 60 years, for the establishment of a connection between Surinam and the world's cable network by means of one or more cables. Among other matters the concession stipulates that during its duration the holder shall enjoy the preference in all cable connections associated with the colony of Surinam, and that therefore no facilities can be granted to another cable company without such facilities being first offered to the French company and being refused by the latter. With regard to wireless telegraphy, the Minister states that negotiations for the establishment of a wireless station for the needs of Surnam were interrupted through the war, but were resumed at the beginning of 1921, and have now been so far advanced that a solution may be expected in the near future. The Surinam Bauxite Co. has established small wireless stations at Paramaribo and at Moengo, and the Liberty Development Co. one at Albina for its own use and for Government messages, which stations can be taken over by the Government at any time. The stations at Paramaribo and Albina are also open for communication with ships at sea, but not with other fixed stations; and the former is also arranged for communications with French Guiana in the event of cable interruptions.

Italy.—WIRELESS SERVICE.—On December 2nd was opened a wireless service between Tempio Pausania on the island of Sardinia and the Centocelle station at Rome. At the Sardinia station was installed a 1.5-kW Marconi cabinet set, while the equipment at the station at Rome was of the kind ordinarily employed in Italy. The rocky nature of the ground at Tempio Pausania caused a large dielectric loss, but 1.5 kW enabled about seven amperes, at 2,300 metres, to be fed to the antenna, which was more than sufficient for clear wireless transmission.

Long-Distance Wireless to Ships.—REDUCTION IN RATES.—Marconi's Wireless Telegraph Co., Ltd., announces that from the 1st instant the charge for private radio telegrams from the Poldhu station to ships at sea has been reduced from 2s. 6d. to 1s. 2d. per word, plus the ship's charge, which is usually 4d. per word.

Switzerland.—STORM DAMAGE.—The whole of Switzerland was in the grip of a blizzard in Sunday, great damage being done to telephone and telegraph wires.

The Telephone Service.—NEW LONDON EXCHANGE.—The new telephone exchange which is to be erected in Wood Street, City, will be the largest in Europe. The site has already been acquired at a cost of some £50,000, but the date when building operations will be begun has not yet been decided. In the plans preparations have been made for probable developments in the next fifteen years. How far the exchange will be automatic will depend upon a variety of circumstances. There are about fourteen automatic exchanges in different parts of the country, but London cannot claim the possession of one. The new exchange will be known as a three-unit exchange, and whereas the existing largest exchanges in London, such as Clerkenwell, which we described last week, have capacity for 10,000 subscribers, the new exchange will cater for 30,000. As, however, no single exchange can consist of more than 10,000 lines, the new exchange will have three separate names, each with 10,000 lines.

THE TOLL EXCHANGE.—Since the London "toll" exchange was opened in September last there has been a steady increase in the use of the service. The average number of calls per week up to the end of December last was as follows:—September, 30,534; October, 32,731; November, 33,311; and December, 34,188. Some 350 calls are passed daily by telephone users to "trunks," whereas the wanted numbers are within the "toll" area. It is in the interests of telephone users themselves to avoid the delay thus caused by using the list contained in the preface to the Telephone Directory.—*The Times*.

NEW SWANSEA EXCHANGE.—The new automatic telephone exchange at Swansea is approaching completion. The building will be finished by September, and four months later the installation will be in working order.

THE WALLASEY EXCHANGE.—The new Wallasey telephone exchange, to which we referred recently, has replaced one of the magneto type and has nearly 2,000 subscribers. The new exchange forms part of a wider programme involving the laying of additional cables not only throughout the Wallasey area, but also in the Mersey Tunnel. Two other exchanges in the Mersey district are to be modernised within the next two years—those at Liverpool Royal and Birkenhead.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—February 20th. City Council. Electricity Department. One rotary converter with transformer, &c.; 6,600 V switchgear. (City Electrical Engineer.)

Victoria Railway Commissioners. March 8th. 35 cabin transformers for power signalling. (Contract No. 34,863.)*

P.M.G.'s Department. March 8th. Switchboard apparatus and parts. (Sched. 545). March 15th. Protective apparatus (Sched. 546).

SYDNEY.—April 24th. Electricity Department. Two 2,000-kW rotary converters, and one 10,000 to 12,000-kW turbo-alternator.*

Aylesbury.—Electricity Department. One 300-kW converter, with e.h.p. and l.p. switchgear. (January 6th.)

Belgium.—February 1st. Municipal authorities of Saint-Trond. Electrically-operated pumping plant at the Veim pumping station. Particulars (3 francs) from the Secretariat Communale, Saint-Trond.

Bulgaria.—SOFIA.—February 14th. Department of Posts, Telegraphs and Telephones. Bronze in plates and bars, iron and steel plates and bars, and insulating materials.*

February 27th. Various electrician's small tools (including pincers, brazing lamps, soldering irons, bits, &c.)*

March 8th. Porcelain insulating tubes for telephones, impregnated paper insulating tubing, ebonite cap, and insulated copper wire.*

Dublin.—January 19th. Electricity Supply Committee. Single and 3-phase meters for 12 months. (See this issue.)

Edinburgh.—January 19th. Corporation. Electric lighting installation at the Public Wash-house, Causewayside. City engineer.

Glasgow.—Corporation. January 16th. Electric lighting installation for the Craigton housing scheme. City electrical engineer.

India.—MADRAS.—February 20th. Corporation. Various paper-insulated, &c., cables already detailed here. Specifications and forms of tender (4s. per set) from the Publisher, ELECTRICAL REVIEW. (December 30th.)

London.—LEWISHAM.—January 23rd. Board of Guardians. Electrical installation at the Children's Home, Cumberlow, Goat House Bridge, Norwood Junction, S.E. (See this issue.)

ISLINGTON.—February 16th. Electricity Department. Electrical and engineers' stores for 12 months, including cables, meters, lamps, wires, carbons, engine-room stores, &c. (See this issue.)

HAMMERSMITH.—January 25th. Electricity Department. Supply, drawing-in and jointing, &c., an additional 11,000-V, three-phase linking-up main between the Fulham and Hammersmith electricity generating stations. (See this issue.)

Newcastle-under-Lyme.—January 17th. Electricity Supply Department. 600 yd. .1, .035, .1 l.p. lead-covered steel armoured distributor cable. (January 6th.)

New Zealand. — WELLINGTON. — February 24th. Public Works Department. Three 11,000-V reactances complete, for the Lake Coleridge electric power scheme.*

DUNEDIN.—March 31st. City Council. One 150-h.p., 3-phase induction motor and reduction gear.*

Spain.—The Postal and Telegraph Department has been authorised to purchase micro-telephonic apparatus to the value of 400,000 pesetas.—*Reuter's Trade Service* (Madrid).

Warrington.—February 6th. Electricity Department. Main e.h.p. switchboard extension. (See this issue.)

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Burton-on-Trent. — Electricity Committee. Recommended :—

Auxiliary pumps (£1,230).—G. & J. Weir, Ltd.
Two 500-kW transformers, £1,603.—Met.-Vickers Elect. Co., Ltd.

Blackpool.—Tramways Committee. Accepted:—

H.p. feeder cable.—British Insulated & Helsby Cables.
L.p. feeder cable.—Pirelli-General Cable Works.

Bolton.—Tramways Committee. Accepted:—

Special tramway rails, points and crossings for the siding at the south end of the wholesale market.—Hadfields, Ltd.

Bradford.—Water Committee. Scar House Reservoir Works.

Two 7-ton electric motor cranes (£4,194).—Thos. Smith & Son (Rodley), Ltd.

Electricity Committee.

One 250-kVA transformer, two electric lifts at Bolton Road sub-station.—English Electric Co., Ltd.
One passenger lift.—Chas. Bell.
One goods lift.—Reliance Lift & Engineering Co., Ltd.

Eastbourne.—Electricity Department. Tenders for new plant :—

One 2,500-kW single-phase turbo-alternator with condensing plant :—

	£
W. H. Allen, Sons & Co., Ltd. (Accepted)	**19,598**
Escher, Wyss & Co.	20,417
Ateliers de Construction Oerlikon	21,333
British Thomson-Houston Co.	23,753
Fraser & Chalmers Eng. Works	23,839
Belliss & Morcom, Ltd.	23,893
Brush Electrical Eng. Co., Ltd. (2,000-kW set)	23,965
English Electric Co., Ltd.	23,990
Richardsons, Westgarth & Co., Ltd.	24,091
J. Howden & Co., Ltd.	24,317
Metropolitan-Vickers Electrical Co., Ltd.	24,470
C. A. Parsons & Co., Ltd.	25,540

For condensing plant only for above turbo-alternator :—

	£
Mirrlees, Watson & Co., Ltd.	**5,703**
Cole, Marchent & Morley & Co., Ltd.	4,815
Hick, Hargreaves & Co., Ltd.	5,834
Richardsons, Westgarth & Co., Ltd.	6,379
Worthington Simpson, Ltd.	6,623
G. & J. Weir, Ltd.	7,567

One water-tube boiler with mechanical stoker, economiser, coal bunkers, chimney, induced draught fan, and engine and pipework :—

	£
Stirling Boiler Co., Ltd. (Accepted)	**16,765**
British Niclausse Boiler Co., Ltd.	17,000
Spearing Boiler Co., Ltd.	17,746
John Thompson Water-tube Boilers, Ltd.	17,910
Babcock & Wilcox, Ltd.	18,124
Clarke, Chapman & Co., Ltd.	20,542

Edinburgh.—Corporation. Accepted:—

106 interpole ventilated traction motors, box frame type, 40 h.p. (£18,020). Metropolitan-Vickers Electrical Co.
106 controllers, for interpole motors (£5,841).—British Thomson-Houston Co., Rugby.
53 car sets of grid resistance (£742).—Electro-Mechanical Brake Co.

Glasgow.—Tramways Department. Recommended:—

Trolley wire.—Thomas Bolton & Sons, Ltd.
⅞-in. stud bolts.—Fleming, Birkby & Goodall, Ltd.
Truck frame forgings.—Brush Electrical Engineering Co., Ltd.
Switchgear for Parkhead.—Whipp & Bourne, Ltd.
Four relays.—Metropolitan-Vickers Electrical Co., Ltd.
Time recorders.—International Time Recording Co., Ltd.

India.—Messrs. Braithwaite & Co., Engineers, Ltd., of West Bromwich, who have received the contract for a steel pipe 114 miles long, 6 ft. diameter, for supplying water to the City of Bombay, India, have ordered from Messrs. Royce, Ltd., of Trafford Park, the full equipment of electrical overhead travelling cranes, eleven in number, for workshops which are being erected for carrying out the work.

Japan.—We are informed that an order was recently received by the Westinghouse Electric International Co. from the Daido Electric Power Co. of Japan for 34 transformers, averaging 9,400 kVA each, a total of 316,400 kVA. They will be single phase, 60 cycle, oil insulated and water-cooled, and will have a voltage of 154,000 volts, which is the highest voltage in commercial use at this time. When installed, they will weigh 50 tons each. The transformers will be installed in a super-power system in the industrial district about Tokio. One of the Japanese stations, planned for Furukawabashi, will contain 18 transformers, with a total output of 169,200 kVA; another at Ohi will have nine transformers with a total output of 82,800 kVA; and a third at Suhara will be equipped with seven transformers with a total output of 64,400 kVA.

London.—The War Office placed a contract for cells with the Edison Swan Electric Co., Ltd., in December.

London and Birmingham.—Mr. W. C. Tackley has received the contracts for the electrical installation work at the British Industries Fair, London and Birmingham, to be held next month.

New Zealand.—Messrs. Boving & Co., Ltd., have recently been awarded a large contract by the Government of New Zealand for water turbines in connection with the Mangahao hydro-electric power scheme. The order includes five main Pelton wheels, three of which will have a maximum output of over 8,000 b.h.p. each, and two of over 4,000 b.h.p. each, also two smaller exciter Peltons each of 325 b.h.p. These machines together will have a total capacity of nearly 33,000 b.h.p. The water wheels will work under an average head of water of 825 feet.

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, January 13th. At the Great Hall, Cannon Street Hotel. At 8 p.m. Smoking concert.

Chief Technical Assistants' Association.—Saturday, January 14th. At Andeston's Hotel, Fleet Street, E.C. At 3 p.m. Discussion on "Utilising Three-phase for One-phase Distribution," to be opened by Mr. J. Goodchild.

Birmingham and District Electric Club.—Saturday, January 14th. At the Grand Hotel, Colmore Row. At 7 p.m. Presidential adddress by Mr. N. Deykin.

Institution of Electrical Engineers.—Joint meeting with the Institution of Heating and Ventilating Engineers. Thursday, January 19th. At the Institution, Victoria Embankment. At 6 p.m. Discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," with introductory papers by Mr. C. I. Haden and Mr. F. H. Whysall.

(North-Midland Centre).—Tuesday, January 17th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Single and Three-phase a.c. Commutator Motors with Series and Shunt Characteristics," by Dr. S. P. Smith.

(Liverpool Sub-Centre).—Monday, January 16th. At the University, Liverpool. At 7 p.m. Exhibition of kinematograph films :—"High-tension Switchgear Tests," by Mr. Torchio, described by Dr. C. C. Garrard; "On Telephone Inventors of To-day," "The Audion," and "Electricity in the Home," exhibited by Mr. F. Gill.

(Western Centre).—Monday, January 16th. At the Merchant Venturers' Technical College, Bristol. At 6 p.m. Lecture on "The Work of the British Electrical Development Association and upon Advertising in Connection with Engineering and Electricity Development," by Mr. J. W. Beauchamp.

(North-Western Students' Centre).—Tuesday, January 17th. At Houldsworth Hall, Deansgate, Manchester. At 7.30 p.m. Paper on "Switching Systems and Lay-outs," by Mr. F. Gough.

(London Students' Section).—Friday, January 20th. At the Institution, Victoria Embankment. At 7 p.m. Paper on "Some Applications of the Thermionic Valve to Telephony," by Mr. L. T. Hinton.

Institute of Cost and Works Accountants.—Wednesday, January 18th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Methods of Remunerating Labour," to be opened by Mr. H. W. Allingham.

Industrial League and Council.—Wednesday, January 18th. At Caxton Hall, Westminster, S.W. Lecture on "Use and Abuse of Combines and Trusts," by Mr. R. Young, M.P.

Institution of Railway Signal Engineers.—Wednesday, January 18th. At the Institution of Electrical Engineers, Victoria Embankment. At 3 p.m. Resumed discussion of paper on "Three-position Signalling."

Northampton Engineering College Engineering Society.—Wednesday, January 18th. At the Northampton Institute, St. John Street, E.C.1. At 5.30 p.m. Kinema exhibition, "Electricity in Steel Works." 6.30 p.m., discussion on appointments.

Chelmsford Engineering Society.—Thursday, January 19th. At the East Anglian Institute of Agriculture. At 7 p.m. Students' meeting.

Chemical Society.—Thursday, January 19th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

Belfast Association of Engineers.—Thursday, January 19th. At the Municipal College of Technology. Paper on "Electricity Supply—Cost to Consumer," by Mr. W. J. M'C. Girvan.

Institution of Mechanical Engineers.—Friday, January 20th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "Some Observations on a Producer-gas Power Plant," by Mr. H. S. Denny and Mr. N. V. S. Knibbs.

British Electrical Development Association.—Friday, January 20th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 8 p.m. Salesmanship conference.

Junior Institution of Engineers.—Friday, January 20th. At Caxton Hall, S.W. At 8 p.m. Lecturette, "Geology in its Relation to Engineering."

Manchester Wireless Society.—Saturday, January 21st. At the Albion Hotel. At 8 p.m. Whist drive and dance.

Electrical Power Engineers' Association (Southern Division).—Friday, January 27th. At the Central Hall, Westminster. At 7 p.m. Lecture on "The Metering of Steam by Means of Orifices," by Mr. J. L. Hodgson.

(Manchester Section).—Thursday, January 19th. At the Association Hall, Peter Street, Manchester. At 7.30 p.m. Address by the President.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

QUERIES addressed to the ELECTRICAL REVIEW, will be answered by post, if the desired information is available, provided the following simple rules are observed :—

1. Address your inquiries to the ELECTRICAL REVIEW, LTD., Service Department, *and enclose a stamped addressed envelope.*

2. Do not ask for information until you have satisfied yourself that it is not already contained in our advertisement pages.

3. If we are the means of putting you in touch with the firm or firms that you require, do us the favour of mentioning the ELECTRICAL REVIEW.

No charge is made for the service.

To complete our answers to inquiries received this week we need the names of manufacturers or suppliers of :—

COLVIN'S commutator compound.

Development of Electricity Supply in Malaysia Deferred.—In February last a party of engineers left this country for the Malay Peninsula, where they were to be engaged on the establishment of hydro-electric and steam power stations in the service of the Government of the Federated Malay States. The work was duly commenced, but unfortunately, as a result of the "slump" in rubber, the Government found it necessary to retrench, and gave the engineers three months' notice. Consequently they left for home on December 16th. They were engaged for one year from the date of their arrival (which took place on April 11th), with a possible extension.

NOTES.

Fire.—Damage to the extent of several thousand pounds was caused by a fire at Cardon Hill granite quarry, Leicestershire, recently. The electric power house was completely destroyed, and two-thirds of the machinery put out of order. —*The Times.*

Late Legal.—BRITISH THOMSON-HOUSTON AND CORONA LITIGATION.—In the Chancery Division on Wednesday, January 11th, Sir D. Kerly, K.C., applied to Mr. Justice Astbury to postpone the hearing of an action by the British Thomson-Houston Co., Ltd., against the Corona Lamp Works, Ltd. The case stood first in the list of warned actions, and in the ordinary course would have been reached on Thursday. Sir D. Kerly said he appeared for the defendant company, and the plaintiff company were represented by Sir Arthur Colefax, K.C., and Mr. J. H. Grey, K.C. The parties were not ready in the case. His position was that he had not got the brief, and his clients were not able to deliver it because they had not the expert's report. The writ was delivered in 1916, so the case had not been hurried up till now. His learned friends agreed with him that it could not be tried for some days. There was another case between the same parties which had just come to an end in the House of Lords. His Lordship said counsel could mention the case again on Thursday.

Selective Tests and Statistics.—At the Conference of the Workers' Welfare Institute at Balliol College, Oxford, on Saturday, on vocational selection, reported in the *Manchester Guardian*, Mr. A. P. M. Fleming (of the Metropolitan-Vickers Electrical Co., Ltd.) dealt with the subject of the use and value of records and statistics, remarking that there were three essentials—they must be based on full information, be absolutely accurate, and be properly interpreted. He had seen in batches of boys admitted at the works entrance, eye and ear troubles, tonsilitis, &c., which would pass undetected in the ordinary way. But under the record system the boys were sent back, and in the great majority of cases the parents had things put right by proper treatment, so that the boys, parents, employers, and above all, the community, were saved from the lingering disadvantage which in the past —and even to a considerable degree in modern times—hampered industry. The whole question of statistics was one of knowing what was important and what was not. Men who considered themselves entirely intimate with every vital factor in their own industries, had been astounded by the revelations of statistical records.

Sawdust as Fuel.—Hitherto, as a result of the gradual development of the factory (an engine being added as the necessity arose for more power) the power required to drive the match factory of Messrs. S. J. Moreland & Sons, Ltd., at Gloucester, was furnished by 13 steam engines, each located in and belt-driving a separate department, the necessary steam being generated in three 30-ft. Lancashire boilers. The fuel consumption amounted to about 80 tons of best steam coal per week, together with all the wood refuse—from 30 to 40 tons per week. The whole plant was most uneconomical, unreliable, and its cost of maintenance high; it was, therefore, decided to substitute for it gas-driven electric plant. The necessary alterations were made in 1918 by the firm's own staff without interfering in any way with the running of the factory. The steam engines were subsequently scrapped, though two boilers were retained for heating purposes only, and they now consume some eight tons of coke breeze per week. The whole of the power required to drive the factory is, therefore, now being derived from wood waste alone, the refuse consisting of waste splints, boxes, sawdust, shavings, &c.; thus, apart from other considerations, a direct saving of 80 tons of steam coal is made per week. The gas-electric power plant is centrally situated in the works, and consists of three sets of Ruston and Hornsby 275-h.p. wood refuse suction gas plant, which supply gas to two Crossley 250-h.p. twin-coupled gas engines, that drive by belt two 170-kW dynamos. In addition, the largest engine which has so far been constructed by Messrs. Fielding & Platt, Ltd., of Gloucester, to consume gas furnished by a producer fired with wood refuse, is installed. The engine has four 17-in. diameter cylinders, a 24-in. stroke, and is designed to develop a maximum of 400 h.p. at a speed of 190 r.p.m. It is direct coupled to a Mather and Platt 250-kW generator. There is also a 60-kW high-speed steam set, which, however, is only used in emergency, either for lighting or driving the air compressors employed for starting the gas engines. All the dynamos are operated in parallel at a pressure of 220 volts, both for lighting and power purposes. The quantity of fuel being consumed at present is between five and six tons per day of 11 hours, the average load during the summer months being about 350 h.p. Taking 5.5 tons as the average daily consumption, the consumption of wood refuse per h.p. hour with that average load is 3.2 lb. The load is, however, considerably increased by lighting and the use of electric heaters during the winter months. With the above fuel consumption there is a yield of from three to four barrels of tar per week, and also a large percentage of acetic acid in the scrubber cooling water. It is proposed to recover that substance at a later date. The whole operation of starting and working the plant is extremely simple, and but three men are required to be in attendance, and apart from its great economy many other advantages have been gained as the result of installing it. There is, for example, better control over the machinery used in the factory processes, both in speed and regularity of output. This remark particularly applies to the four-cylinder engine, the regularity of working of the gas plant having been considerably improved by its installation. The Fielding engine has operated with great regularity, no occasion having arisen to shut it down in consequence of any defect. The gas plant also has worked without a hitch in spite of the difficult nature of the fuel used, and so well is the gas cleaned that, after three months' working, there was hardly sufficient dirt on the gas valves of the engine to necessitate removing them for cleaning purposes. A remarkable feature of the plant is the steady running of the engine and the absence of noise when working, the operation being considered to be equal to that of a high-class steam engine.—*Engineer.*

Appointment Vacant.—Engineering assistant, for the South Shields Corporation Electricity Supply Department. (See our advertisement pages to-day.)

The Electro-Harmonic Society.—At to-night's smoking concert, which will be held in the Great Hall, Cannon Street Hotel, commencing at 8 p.m., Mr. William Peto will take the chair. The following are the artistes:—Madame Ethel Dyer, soprano; Mr. Ernest Hargreaves, tenor; Mr. Walter Saull, baritone; Mr. Charles Leggett, cornet; Mr. Sterndale Bennett, entertainer; Mr. Nelson Jackson, entertainer; Mr. Will Edwards, humorist; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

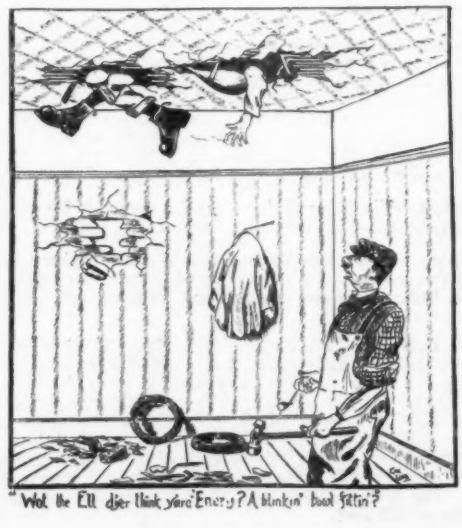
Signalling Service in the Territorial Army.—Lieut.-Col. M. W. Emley, commanding the 3rd (London) Corps Signal Cos., desires to call attention to the urgent need of this unit for recruits with electrical trajning. The work of "Corps Signals" is no doubt well known to most of our readers; as now organised, this unit consists of four companies: Wireless, construction, cable, and head quarters, with artillery sections attached. It will be understood that it is difficult to organise and maintain such a unit without the close co-operation of electrical firms and employés.

A man and his employer both gain benefits from his belonging to a unit such as this. To the man it means fourteen days' free holiday in the summer, usually by the sea, with pay and an easily earned £5 bounty each year, whilst the knowledge which he acquires technically cannot come amiss in his civilian capacity. Further, head-quarters provides a free club. Drills always take place at times fixed to suit men who earn their living. The gain to the employer is apparent after the first annual training, for the man is almost invariably a better servant as the result of his military training.

Another important point is that of economy. A Territorial unit costs a very small fraction of the cost of a corresponding regular unit, and if the Territorial units are not recruited up to strength an increase of regular or militia units seems inevitable.

Lieut.-Col. Emley appeals to such of our readers as are themselves in a position to enlist, or to give encouragement as regards leave for camp, &c., to their employés, to do so, and thus to give the practical help of which the unit is in need. Prospective recruits can enlist at Head-Quarters, Elverton Street, S.W., any morning from 10 to 1, and any evening from 7 to 10, and the officer commanding will be glad to furnish fuller particulars to any of our readers who may like to have them.

Erratum.—In connection with the article on "Power Factor," by Mr. E. W. Dorey, in our last issue, by a printer's error which we regret, the letters "M.I.E.E." appeared after his name instead of "A.M.I.E.E."



Mme. Curie and the Académie de Médecine.—Among the candidates for seats upon the board of the French Academie de Medecine is Madame Curie. Although she has the support of a number of the most prominent members of the Academy, her candidature is opposed by several members, who object to the election of women to the board.

INSTITUTION NOTES.

The Institution of Electrical Engineers.—On Thursday, January 19th, a joint meeting with the Institution of Heating and Ventilating Engineers will be held. There will be a discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," with introductory papers by Mr. C. I. Haden and Mr. F. H. Whysall.

LIBRARY.—As a result of the experience obtained by keeping the library open every evening and on Saturday afternoons during the last few weeks, the Council of the Institution has decided that in future the library will be kept open until 9.30 p.m. on the nights on which are held the ordinary meetings of the Institution, the informal meetings, and meetings of the Wireless and Students' Sections. It appears that on evenings when no meetings are held, the library is not made use of.

WESTERN CENTRE.—At a meeting to be held in Bristol on January 16th, Mr. J. W. Beauchamp, M.I.E.E., will deliver a lecture, "On the Work of the British Electrical Development Association and upon Advertising in Connection with Engineering and Electricity Development Generally." The President of the Institution is to visit the Centre at Cardiff on February 6th.

LIVERPOOL SUB-CENTRE.—At an ordinary general meeting on January 16th the following kinematograph films will be exhibited:—"High-tension Switchgear Tests," by Mr. P. Torchio, described by Dr. C. C. Garrard; and "Telephone Inventors of To-day" and "Electricity in the Home," by Mr. F. Gill, O.B.E.

Chemical Society.—At a meeting to be held on January 19th, Prof. Arthur Smithells, F.R.S., will give an account of Langmuir's theory of atomic structure and exhibit models.

Iron and Steel Institute.—The annual meeting of the Institute will take place on May 4th and 5th at the Institution of Civil Engineers, Great George Street, S.W.1, by kind permission of its Council. The annual dinner will be held on May 4th, at the Connaught Rooms. Particulars of the cost of the dinner, and details of the arrangements, will be circulated later. In March the Council will be prepared to consider applications for grants from the Carnegie Fund, in aid of research work, of such value as may appear expedient. The awards are made irrespective of sex or nationality. Special forms, on which candidates should apply before the end of February, can be obtained from the secretary of the Institute.

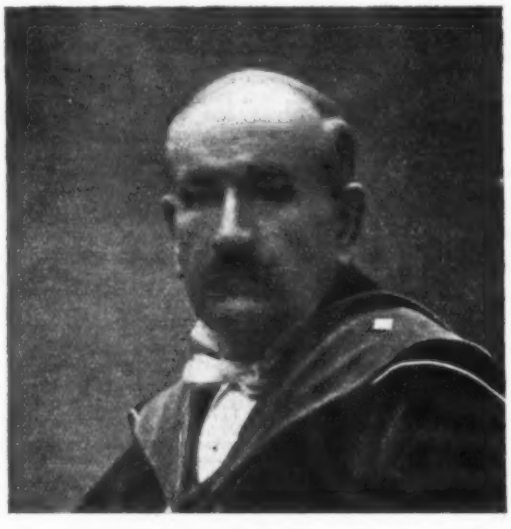
Royal Society of Arts.—Among the arrangements for the next few months are two Cantor lectures on February 20th and 27th, at 8 p.m., by Mr. A. F. C. Pollard, A.M.I.E.E., on "The Mechanical Design of Scientific Instruments" and a lecture on February 24th, at 4.30 p.m., by Prof. W. A. Bone, D.Sc., F.R.S., on "Brown Coals and Lignites: their importance to the Empire."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The following Press communiqué has recently been issued from Delhi:—"The Secretary of State for India, having accepted the main principle of the recommendations of the Stores' Purchase Committee, regarding the agency to be established for the purchase and inspection of stores for Government Departments in India, the Government of India has obtained his approval as a preliminary measure to the appointment, on a temporary basis, for a period of two years in the first instance, of the three chief officers of the new Indian Stores Department, viz., Chief Controller of Stores, Director of Purchases, and Intelligence and Chief Inspector." For the appointment of Chief Controller, the Government of India has selected Mr. J. S. PITKEATHLY, C.I.E., C.V.O., C.B.E., D.S.O., superintending engineer (electrical and mechanical), Delhi. Mr. Pitkeathly will assume charge of his office in January, 1922, and will then proceed to "formulate a detailed scheme of organisation for the consideration of the Government of India." One of our special correspondents in India writes:—"Mr. Pitkeathly is well known among the commercial community in India for his fairness, straight dealing and integrity, and no better or sounder choice could have been made for such an extremely important appointment. He has filled many important Government posts in India, since coming out about 1905, with conspicuous ability, as is evidenced by the honours which have been showered upon him. Having shown his skill as an organiser at the Allahabad Exhibition in 1910, the entire electrical equipment of which he controlled, he was chosen to take entire charge of the electrical arrangements for the Delhi Durbar, 1911. This was one of the largest electrical schemes of the sort which had ever been carried out in India, and its wonderful effect was a marvel to all who were privileged to witness it. Delhi having been proclaimed as capital of India instead of Calcutta, Mr. Pitkeathly was chosen as electrical engineer to the new Delhi Province in 1912. The discriminating eye of authority there soon detected his versatility and efficiency, and in addition to his ordinary duties he was commissioned to build a new Secretariat of vast proportions to house clerks and officials of the new capital. This he did in record time. Soon after war broke out he was sent to Mesopotamia and made colonel R.E. in charge of the electrical and mechanical branch of the military works. His valuable services there were officially appreciated by his being awarded the D.S.O., and later on the C.B. decoration. On demobilisation he again resumed his work at the new Delhi Province as superintending engineer, electrical and mechanical branch. His wide Indian administrative and business experience will be a valuable asset in his new post, and his tact, courtesy, and sympathy towards the Indian and European alike should smooth his official path to even higher honours still. His present appointment carries great responsibilities and heavy burdens, but knowing the man one feels that his success is already assured."

We are pleased to be able to publish this week a portrait of Dr. C. O. MAILLOUX, of New York, President of the International Electrotechnical Commission. Dr. Mailloux's devoted labours on behalf of the promotion of friendship and goodwill between the electricians of the world are, we think, not sufficiently recognised. It is therefore a pleasure to find that at the recent Ampère Centenary celebrations in Paris, at which



DR. C. O. MAILLOUX.

Dr. Mailloux took a leading part in presenting, on behalf of numerous American universities, colleges and societies, written tribute to the great work of Ampère, he subsequently was made an Officer of the Legion of Honour. This well-merited distinction shows how deeply our French colleagues appreciate Dr. Mailloux's efforts for so many years to bring the French and American electricians together, which task, through his extraordinary linguistic ability and love for France, he has so eminently and large-heartedly accomplished. Dr. Mailloux also represented the French Academy of Sciences at the Ampère Centenary celebrations held in December, 1920, at Ampere City, New Jersey. We, too, in this country owe Dr. Mailloux a debt of grititude for the part he has taken in promoting the welfare of the I.E.C. since its initiation. We well remember his strenuous efforts in 1905 to straighten out the tangled difficulties of the proposed constitution of the I.E.C. and the hard work of the small committee, the members of which gave up participation in the interesting tour round the country which had been arranged for the delegates by the Institution of Electrical Engineers. The constitution of the I.E.C. was argued out in close detail, and Dr. Mailloux was able repeatedly to smooth out with equal facility, whether a Spaniard, an Italian, a Frenchman, a South American, or a Portuguese was concerned, the many difficulties which inevitably arise when such matters are discussed in any international conference.

The *Echo de Paris*, which recently opened a national subscription to enable the octogenarian scientist, M. Edouard Branly, to continue his research work in connection with wireless telegraphy, announces that the fund already exceeds 200,000 fr. (about £4,000), which it is considered will be sufficient for the inventor's present and future needs.

Mr. W. NORTH-LEWIS, J.P., chairman of Insoles, Ltd., and the Windsor Steam Coal Co., Ltd., has been appointed chairman of the Treforest Electrical Consumers' Co., Ltd., in place of the late Mr. Hugh Bramwell, O.B.E.

Mr. W. RUTHERFORD has been elected a director of G. D. Peters & Co.

At the office of the British Insulated & Helsby Cables, Ltd., Helsby, Mr. GEORGE LLOYD was presented with a gold watch by the members of the works staff, on one occasion of his departure from Helsby. The presentation was made by Mr. W. B. Barlow.

Mr. PRANGNELL has severed his connection with Messrs. C. A. Parsons & Co., Ltd., at Heaton Works, and has started for himself as a manufacturers' area representative, with offices at 47, Pilgrim Street, Newcastle-on-Tyne.

MR. H. E. SUTHERLAND has relinquished his position as chief engineer and designer to the Midland Electric Manufacturing Co., Ltd., Birmingham. His present address is 47, Russell Road, Hall Green, Birmingham, where he will devote himself to industrial and mining switchgear.

Obituary.—MR. ERNEST HOLT.—The interment took place at Halifax on FRIDAY last of the late Mr. Ernest Holt, manager for the past ten years of the Ashton-under-Lyne Corporation Tramways. Mr. Holt was taken ill shortly after Christmas, and passed away from pneumonia within less than a week. He entered the service of the Ashton Tramways in 1905 as chief clerk, and his death, at the early age of 37 years, is deeply regretted.

SIR WILLIAM MATTHEWS.—We regret to record the death, which has occurred at Hampstead at the age of 78 years, of Sir William Matthews, K.C.M.G., a famous engineer, who was responsible for harbour construction work in all parts of the world, and was a past president of the Institution of Civil Engineers.

MR. J. E. RENDELL BAKER.—We briefly mentioned last week the death of Mr. J. E. Rendell Baker, engineer and manager of the Stratford-on-Avon Electricity Co., Ltd., and formerly of Finchley, London. Mr. Rendell Baker died on December 18th, after a long and trying illness. During the illness his position was temporarily held by his youngest brother (W. Rendell Baker), and we learn that the directors of the company have now appointed him to his brother's position. We understand that the family has an interesting electrical record. The father (Robert R. Baker), who was for a great many years gas and electric fittings superintendent under the Bolton Corporation and who is still on their retired list, has his three remaining sons managing municipal undertakings at Devizes, St. Helens, and Stratford-on-Avon, respectively.

Will.—The late Ald. J. FIELDING, joint managing director of Fielding & Platt, Ltd., of Gloucester, left £48,270 gross and £41,901 net.

NEW COMPANIES REGISTERED.

Sterling Accessories, Ltd. (178,768).—Private company. Registered December 31st. Capital, £1,000 in £1 shares. To carry on the business of electrical, telephone, telegraph, mechanical, and general engineers, electricians, fitters, millwrights, &c. The permanent directors are: C. J. Margerison, "Weston," St. James' Avenue, Sutton, Surrey (chairman); A. Handley, 42, Great Charles Street, Birmingham. Qualification of permanent directors, £300; of other directors, £200. Registered office: Bangor House, Shoe Lane, E.C.

Charles H. Champion & Co., Ltd. (178,837).—Private company. Registered January 4th. Capital, £10,100 in 1,000 8 per cent. non-cumulative preference shares of £10 each and 2,000 ordinary shares of 1s. each. To carry on the business of producers and suppliers of electrical apparatus, manufacturers and importers of and dealers in cables, lines, wires, dynamos, accumulators, meters, &c. The provisional directors are: Henri Marcotty, 71, Castleton Mansions, Barnes, S.W.13; C. H. Champion, National Liberal Club, Whitehall; G. H. Leslie, Junior Naval and Military Club, 96, Piccadilly, W. Solicitors: Macdonald & Stacey, 2, Norfolk Street, Strand, W.C.

Harper Brothers & Co., Ltd. (178,787).—Private company. Registered January 2nd. Capital, £1,000 in £1 shares. To tender for, undertake, and carry out works, operations, contracts, or transactions in Spain or elsewhere in connection with power undertakings or of any kind whatsoever commonly undertaken by engineers, builders, contractors, or power suppliers, &c. The subscribers (each with one share) are: G. J. Webadale, 87, The Avenue, Highams Park, Essex, engineer; A. J. Bennell, 13, St. Helen's Place, E.C.3, secretary. The first directors are W. A. Harper and H. W. Harper. Registered office: 13, St. Helen's Place, E.C.3.

A. G. Burrell & Co., Ltd. (178,803).—Private company. Registered January 3rd. Capital, £5,000 in £1 shares (1,500 6 per cent. cumulative preference). To adopt an agreement with A. G. Burrell for the acquisition of the business carried on by him as "A. G. Burrell & Co.," and to carry on the business of manufacturers, installers and repairers of and dealers in systems and installations of all kinds for synchronising or distributing time, and of all master and secondary clocks, dials, batteries, alternators, dynamos, wiring, and other appliances, &c. The first directors are: J. W. Molden (chairman), "Narbestrong," Coombe Hill Road, Kingston; W. E. Spearing, 51, Bushwood Road, Kew; D. B. Saunderson, "Benridge," Frithwood Avenue, Northwood, Middlesex; A. G. Burrell, 57, Barkers Road, Nethereage, Sheffield. The three first-named may retain office so long as they are directors of the Magneta Time Co., Ltd. The said A. G. Burrell shall be a director for seven years if he shall so long remain manager of the company. No qualification required for a director who is also a director of the Magneta Time Co., Ltd. Qualification of other directors, 200 ordinary or preference shares. Registered office: 29, Change Alley, Sheffield.

Standard Wiring, Ltd. (11,985).—Private company. Registered December 28th. Capital, £1,000 in £1 shares. To carry on the business of electricians and engineers, &c. The subscribers (each with one share) are: A. V. Froggatt, 131, West Regent Street, Glasgow, marble merchant; W. Marshall, 9a, Hope Street, Glasgow, accountant. The first directors are not named. Secretary: D. More. Registered office: 37, Bank Street, Kilmarnock.

Robin Adair, Ltd. (178,736).—Private company. Registered December 30th. Capital, £500 in £1 shares. To carry on the business of import and export merchants and agents, mechanical and electrical consulting engineers, &c. The subscribers (each with one share) are: Percy Adair, 32-4, Holborn Viaduct, E.C.1, electrical engineer; W. J. Woodhouse, 3-4, Clement's Inn, W.C.2, articled clerk. The first directors are not named. Registered office: 32-4, Holborn Viaduct, E.C.

Henderson & Thornton, Ltd. (178,865).—Private company. Registered January 5th. Capital, £2,000 in 500 10 per cent. cum. pref. and 1,500 ordinary shares of £1 each. To carry on the business of producers and suppliers of electrical apparatus, manufacturers of and dealers in cables, lines, wires, dynamos, accumulators, &c. The first directors are: F. Higgs, Station Works, Hinton Road, Herne Hill, S.E.; B. C. Aldous, Station Works, Hinton Road, Herne Hill, S.E.; J. A. Henderson, 18, Mount Ephraim Road, Streatham, S.W.; L. Thornton, 16, St. George's Road, West Hampstead, N.W. Solicitors: Macdonald & Stacey, 2, Norfolk Street, Strand, W.C.2.

Mikro, Ltd. (178,794).—Private company. Registered January 2nd. Capital, £5,000 in £1 shares. To take over the sole working rights for the world, except U.S.A. and Canada, of the patent Skinderviken Transmitter Button, and the various appliances containing the same or emanating therefrom, with all trade marks, designs, and royalties connected therewith, from Johan Skinderviken, of 3, Colosseum Terrace, N.W.1. The first directors are: Johan Skinderviken, 3, Colosseum Terrace, N.W.1; H. A. Walliss, 4, Holly Villas, Clarendon Road, S. Woodford, E.18. Advertising consultant (general manager). Registered office: 12, Bouverie Street, E.C.4.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

J. B. Saunders & Co., Ltd. (112,037).—Return dated November 16th, 1921. Capital, £20,000 in £1 shares. 18,000 shares taken up and considered as fully paid. Mortgages and charges: Nil.

Stothert & Pitt, Ltd. (74,218).—Return dated November 7th, 1921. Capital, £350,000 in £1 shares (250,000 ordinary and 100,000 preference). 191,585 ordinary and 79,788 preference shares taken up; £123,623 paid; £145,750 considered as paid. Mortgages and charges: £25,000 first and £30,000 second debentures.

Midland Counties Electric Supply Co., Ltd.—Particulars of 400,000 7½ per cent. mortgage debenture stock, authorised November 21st, and covered by trust deed dated December 14th, 1921; whole amount issued; charged on shares and stock in various companies and the company's undertaking and property, present and future, including uncalled capital subject to prior stock and secured notes. Trustees: British Trusts Association, Ltd.

Creed & Co., Ltd.—Satisfaction in full on December 12th, 1921, of mortgage dated March 25th, 1918, securing £3,000.

CITY NOTES.

Lisbon Electric Tramways Co., Ltd.

The "City" columns of *The Times* contain a comment based on a letter from that paper's correspondent at Lisbon regarding the crisis which has been reached in the affairs of this company. Down to 1914, says the writer, the company met with a fair measure of success and was able to accumulate a large reserve fund. "Its subsequent experiences have been of the nature common to transport undertakings the world over, namely, an increase in working costs out of all proportion to the additional gross revenue, despite heavily increased tariffs. The troubles of this undertaking have been rendered the more acute by reason of the heavy depreciation of the national currency—the escudo (nominally worth 53½d.) having a present value of 4½d. as compared with about 46d. just before the outbreak of war. Last summer, following a long strike, an agreement was made with the Government whereby, in return for a temporary increase of pay made by the company to its servants, the Government appointed a Commission to inquire into the financial position of the undertaking, and promised to support the report of the Commission. This report, which proposed several ways of increasing the company's receipts, duly appeared, but the time limit has now expired in which the Camara was to have refused or accepted the findings of the Commission, and the Camara still refuses to be moved. A last appeal has just been made to the Portuguese Prime Minister, calling upon the Government to comply with the terms of the agreement. It is obvious that the existing situation cannot continue much longer, for every week the company is adding to its losses, and its reserve fund has now been used up."

Italian Companies.

Società Mineraria ed Elettrica del Valdarno (Florence).—This company, whose capital is 100,000,000 lire, closed its financial year with a loss of 1,667,301 lire. The shareholders approved the report of the board, which explained that the loss was occasioned by extraordinary events which arose during the year. Note was also taken of the failure of the issue of 500,000 shares which occurred in the preceding year, the shareholders not having subscribed the amount asked for by the board. It was decided to reduce the capital to 50,000,000 lire, setting aside the 6,388,417 lire subscribed by the shareholders for a new meeting to dispose of in the interests of the company.

Dinamo, Società Italiana per Imprese Elettriche (Milan).—The report of the board of this company, whose capital is 25,000,000 lire, showed that the working year, closed on June

30th, had not terminated in favourable circumstances. The balance-sheet disclosed a net profit of 1,694,405 lire, allowing of a distribution of 6 lire per share. The meeting had under consideration the removal of the company's headquarters to Varzo, and the increase of the capital to 30,000,000 lire.

Società Distribuzioni Elettriche Zambellini (Port Maurizio).—The working year of this company (capital 5,000,000 lire) closed on June 30th with net profits of 679,907 lire, allowing of a dividend of 10 lire per share. To facilitate amalgamation with other important distribution centres, the meeting decided to raise the capital to 8,000,000 lire.

The following Italian companies have raised their capital:—Idroelettrica Veneta (Venice), from 5,000,000 to 50,000,000 lire; Idroelettrica dell' Ossola (Milan), from 630,000 to 2,000,000 lire; Società Anonima Elettrica Moltrasina, from 100,000 to 125,000 lire; and the Società Anonima Luce e Forza (Parabiago), from 324,000 to 1,000,000 lire.

Douglas Southern Electric Tramways, Ltd.—The report of the directors stated that an agreement had been entered into with the Douglas Head Marine Drive Co., Ltd., by virtue of which, at the end of the concession in 1926, the Drive Co. would take over the tramways as a going concern, paying therefor the agreed or arbitrated value of the company's mechanical and electrical plant, and half the value of the permanent way. An interesting table of figures showing traffic results was presented. The number of service days in 1921 was 96 (1920, 130); passengers carried 181,242 (1920, 267,671); car mileage, 25,240 (1920, 32,420); traffic receipts, £8,082 (1920, £13,539); total receipts (less tolls), £8,062 (1920, £11,763); expenses, £5,637 (1920, £5,737); net profit, £2,425 (1920, £6,025). On the ordinary shares a dividend of five per cent. was declared.

S. Smith & Sons (Motor Accessories), Ltd.—In the course of his speech at the recent annual meeting, Mr. Chas. P. Newman said that the company acquired a controlling interest in the business of H. W. Smith & Co. in 1920, at a time when it was impossible to obtain electric wire and cable in connection with their lighting sets. The business was regarded as a good one, and in the ordinary course of events would have been kept fully employed on manufacturing for this company; but, unhappily, when the depression became acute this business suffered in common with all others, and it was found impossible to carry on at a profit, with the result that a receiver had been appointed. They had written off the whole of the value of these shares, although it was not without hope that some scheme of reconstruction might be possible.

French Companies.—*Etablissements Pazet Silva.*—The ordinary meeting of this company was held on December 10th, when the accounts for the year's working were approved. The balance-sheet showed net profits of 27,708 fr., which was carried over to the profit balance of the foregoing year, making a total of 548,453 fr. The report attributed the small profit made to the reductions in the sale price of lamps and other articles, induced by the desire to stimulate business. The past year had suffered from the crisis in commerce and industry; nevertheless the level of business transacted equalled that of the previous year.

German Companies.—The *Gesellschaft fur Elektrische Unternehmungen*, of Berlin, is at present inviting subscriptions for 75,000 shares of 1,000 marks each at a premium of 150 marks.

The *Rheydt Kabelwerk Gesellschaft*, of Rheydt, is increasing its capital to the extent of 25,000,000 marks, 25,000 shares of 1,000 marks each being offered for subscription at a premium of 200 per cent.

South Wales Electrical Power Distribution Co.—According to the financial Press, the Bill that is being promoted by this company states in the preamble that the ordinary capital issued amounts to £610,120, whereas the assets are valued at only £152,530, a difference of £457,590. The proposal is to reduce the capital as from January, 1923, to £152,530 by cancelling capital not represented by assets, the reduced capital to be held by the present holders in the proportion of £2 10s. for each existing £10.

Anglo-American Telegraph Co., Ltd.—The directors announce final dividends of £1 10s. per cent. on the consolidated ordinary and preferred stocks, less tax, and a first and final dividend of £1 10s. per cent. on the deferred stock for 1921, less tax. A bonus of 2s. 3d. per cent. is to be paid on the undivided ordinary stock and 4s. 6d. on the deferred, free of tax.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—Profit for the year ended September 30th, 1921, £31,448. Total receipts amount to £105,628. Allocations to the various reserve funds total £16,078; written off cost of motor vehicles, £864. Half-year's dividend, due July, 1908, was paid on preference shares, leaving to be carried forward £3,972, against £4,284 brought in.—*Financial Times.*

Provincial Tramways Co.—According to the *Financial Times* the revenue for the year to September 30th, 1921, was £20,900, against £40,016 for the previous year. A claim for E.P.D. in respect of 1918, amounting to £12,454, has necessitated a big strain on the company's resources.

Kaministiquia Power Co.—Dividend at rate of 8 per cent. per annum on common stock for the quarter ending January 31st.

STOCKS AND SHARES.

TUESDAY EVENING.

MONEY in the New Year shows every indication of remaining cheap for some time to come, and with discount rates falling in the money market, the tendency for Stock Exchange securities is naturally to improve. This applies, of course, to money stocks mainly. In spite of the enormous amount of new issues during the past four weeks, public demand is sufficiently eager to absorb practically any good stock that comes along at a reasonable price. It might have been imagined that this would impose a check upon the advances which have been taking place in stocks already existing, but in point of fact, the reverse is happening.

The search for sound securities does not confine itself to the new stocks, and is busily exploring other markets in which there are still opportunities for profitable employment of money. Even with recently-issued debentures and the like, the demand is strong enough to maintain premiums, as for example in the case of the Reading Electric debenture now up to 5 premium. The Llanelly & District debenture has risen to 2 premium. Midland Counties 7½ per cent. debenture stock, which hung fire a little at the outset, has strengthened to 3 premium. The attraction of this stock was mentioned here on two or three occasions, owing to the fact of its being backed by the British Electric Traction Co. Incidentally, it may be mentioned that the ordinary stock of the latter is one of the firmest features this week, showing a gain of 5 points at 36. The difficulty which most stockbrokers experience at the present time is to get the offer of investment securities at prices which appear reasonable to their clients. Holders are not inclined to sell, and there is just sufficient hope of a fall in the Income Tax in April to encourage the idea that, should this take place, a sharp impulse would be given to business enterprise and initiative. On the other hand, the Trade Returns from various industries are not all satisfactory. The amount of capital required for trade, therefore, is not yet large enough to cause a diversion of money from stocks into stock-in-trade, but with the realisation of capitalists that their money on deposit is earning but a very modest rate, the cash hitherto lodged with the banks is steadily coming back into Stock Exchange securities, increasing the demand, and having the effect of strengthening quotations in every market which it touches.

The Home Railway department stands out as one of the strongest of the week. Amongst Undergrounds, rises have occurred in Metropolitan, Central London assented stock, and Districts. Underground shares are better at 2½. The main advances, however, are to be found in the lists for prior-charge stocks. Metropolitan 3½ per cent. debenture has risen to 64, and the "A" stock to 60¼. Central London non-assented ordinary stock is higher at 35½, the preferred at 43¼ and the deferred at 32½. It is interesting to notice that, although the preferred stock is quoted at the price mentioned, the last business marked was at 37½ at the end of September, 1921. Districts 4½ per cent. first preference at 63½ and London Electric preference at 69 are both better. East London debentures have risen noticeably, the four classes now standing at 60½, 38, 18½, and 11, while the company's first debenture stock is 54, ex-dividend.

The same cause is at work amongst electricity supply shares, where advances have occurred in County ordinary and preference, Kensingtons, Metropolitans, St. James's and Westminsters. The jobbers frankly confess that they have little stock to offer, while, at the same time, there is continual pressure to buy. The manufacturing group feels the reflection to a minor extent. Improvements have occurred in Edisons, English Electric preference, General Electrics, and Siemens. Amongst the telegraph manufacturing shares, rises are to be noted in Telegraph Constructions at 2, Henleys at 30s. 6d. and Callenders 28s. 3d. There are few investment markets, in fact, which fail to participate in the strength brought about in the first instance, by the forcing-out of deposit money from the banks. There is talk also of a possible fall in the bank rate on Thursday in this week, having regard to the fact that the Federal Banks of New York lowered their rate before Christmas. This step is usually followed almost immediately by a similar movement in the Bank of England rate, but it was decided that nothing should be done until the turn of the New Year. Moreover, if the Irish question is going to be settled peacefully, and if there is any chance of the Cannes Conference bringing about a better state of affairs on the Continent, with a more stable rate of exchange between the various countries, then the investor will regain a confidence which he has not felt for five or six years past.

In the telegraph and telephone list, the principal feature is the way in which Anglo-American stocks have improved. The preferred is up 3½ points and the deferred gained 15s. The company's dividend announcement appeared the other day, and, although the preferred received no more, of course, than the 6 per cent. to which it is entitled, the deferred stock in addition to its fixed 1½ per cent., gets a bonus of 4s. 6d. per cent., which has the effect of increasing the yield to 9 per cent. for a security which is sufficiently good to render a rise in price, to 90 at least, quite possible. The Eastern group of stocks and shares is decidedly strong, with

advances in Globes, Eastern ordinary, Eastern Extensions, and Western shares. Here again the difficulty is to get the stock wherewith to supply insistent buyers. United River Plates have hardened to 5 5/16, Marconis are better at 1¾, Indo-European at 30½ are three points to the good, and the market throughout exhibits noticeable firmness.

Amongst the new issues which are pouring out like water from every side, it is remarked in the Stock Exchange that the electricity supply companies have not yet formulated appeals for capital which were rather expected to be forthcoming early this year. The prices of new electrical issues, as already noted, remain on the upward track. British Thomson-Houston debenture is up to 2¼ premium, and looks as though it will improve still further. Clyde Valley Electrical 8 per cent. second preference remain at 5¼ for the £10 shares, with £5 paid. The Fife Tramways Co. is on the point of making an issue of £250,000 7 per cent. debenture stock at 93.

British Columbia Electric Railway stocks have again spurted, on the expectation that the report, due immediately, will make a very good showing. The rises range from 1 to 5 points, and stand out as the most prominent feature in their particular market. British Electric Tractions are steady at 31¼. Anglo-Argentine Tramways 5 per cent debenture stock, so frequently recommended here as a sound investment, is 2 points higher at 65¼. Mexicans are neglected, and the tendency is to let prices droop.

Business in rubber shares has come to something like a full stop, owing to the unsatisfactory condition of the market in the raw produce. The Armament group is tame. There is not much doing in engineering shares, but Babcock and Wilcox at 47s. 6d. are a shade better on the week. Victoria Falls preference at 18s. 6d. and the ordinary at 9s. are unaffected by the serious strike that has occurred in the Transvaal gold and coal mining industries.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend. 1919.	1920.	Price Jan. 10, 1922.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	14	6⅝	—	£9 1 2
Charing Cross Ordinary	7	8	4⅜	—	8 18 8
do. do. do. 4½ Pref.	4½	4½	2⅝	—	7 4 4
Chelsea	4	6	3½	—	8 11 6
City of London	13	14	1⅞	—	9 14 10
do. do. 6 per cent. Pref.	6	6	18/6	—	6 9 9
County of London	8	8	9	+ ½	8 17 10
do. do. 5 per cent. Pref.	6	6	8½	+ ½	7 7 8
Kensington Ordinary	7	9	6½	+ ⅛	8 11 6
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 12 0
Metropolitan	6	7	4	+ ½	8 15 0
do. 4½ per cent. Pref.	4½	4½	2½	—	7 13 2
St. James' and Pall Mall	12	12	6¼	+ ⅛	8 14 6
South London	6	7	2½	—	10 9 0
South Metropolitan Pref.	7	7	17/6	—	8 0 0
Westminster Ordinary	10	10	6	+ ½	8 6 8

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	6	6	88	+2½	6 16 4
do. Def.	1½	1½	10½	+ ⅛	9 0 0
Chile Telephone	6	6	8½	+ ½	5 14 8
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16⅞	+ ⅛	5 19 5
Eastern Tel Ord.	10	10	168½	+2	5 18 8
Globe Tel. and T. Ord.	10	10	16⅞	+ ⅛	5 19 5
do. do. Pref.	6	6	9⅞	+ ⅛	6 3 1
Great Northern Tel.	22	24	25½	—	9 1 2
Indo-European	10	10	30½	+1	8 5 4
Marconi	25	15	1¾	+ 1/16	8 11 6
Oriental Telephone Ord.	12	12	2	—	*8 0 0
United R. Plate Tel.	8	8	5 1/16	+ 1/16	*6 14 9
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	16⅞	+ ⅛	*5 19 5

Home Rails.

Central London Ord. Assented	4	4	53½	+1	7 12 5
Metropolitan	1½	1½	27	+ ½	5 11 1
do. District	Nil	Nil	21½	+1	Nil
Underground Electric Ordinary	Nil	Nil	2⅛	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	76½	+1	*3 18 6

Foreign Trams, &c.

Anglo-Arg. Trams, First Pref.	5½	12½	92xd	—	10 9 6
do. do. 2nd Pref.	Nil	5½	21⅝	—	7 17 3
do. do. 5 per cent. Deb.	5	5	65½	+2	7 12 6
Brazil Tractions	Nil	Nil	31⅛	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	61½	+3½	8 2 8
do. do. Preferred	5	93/-	57½	+5	*8 2 2
do. do. Deferred	3	124/-	69	+9½	*10 8 4
do. do. Deb.	4½	4½	62½	+1	6 16 0
Mexico Trams. 5 per cent. Bonds	Nil	Nil	54½	−1	—
do. do. 6 per cent. Bonds	Nil	Nil	25½	−1	Nil
Mexican Light Common	Nil	Nil	13	—	Nil
do. Pref.	Nil	Nil	27	—	Nil
do. 1st Bonds	Nil	5	59½	−2	8 8 0

Manufacturing Companies.

Babcock & Wilcox	15	16	23	—	6 14 9
British Aluminium Ord.	10	10	15/6	+6d.	—
British Insulated Ord.	15	15	1¾	—	10 0 0
Callenders	15	15	28/3	+9d.	10 12 4
do. 6½ Pref.	6½	6½	18/9xd	—	6 18 8
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	—	6/6	+6d.	—
do. do. 5 per cent. Deb.	5	5	62xd	—	8 1 4
Electric Construction	10	10	18/3	—	10 19 2
English Electric	8	8	10/-		16 0 0
do. Pref.	6	6	13/9	+ 1/16	8 14 6
Gen. Elec. Pref.	6½	6½	17/9	+6d.	7 6 6
do. Ord.	10	10	18/9	+6d.	10 1s 4
Henley	15	15	30/4	+9d.	9 16 8
do. 4½ Pref.	4½	4½	8½	—	8 4 2
India-Rubber	10	—	1/16	—	—
Met.-Vickers Pref.	8	8	1½	—	9 2 10
Siemens Ord.	10	10	22/-	+9d.	*9 1 10
Telegraph Con.	20	20	22	+ ½	*5 9 9

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 11th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic per lb.	8½d.	..
a Ammoniac Sal per ton	£66	..
a Ammonia, Muriate (large crystal) „	£38	..
a Bisulphide of Carbon „	..	..
c Borax „	£31	..
a Copper Sulphate „	£29	..
a Potash, Chlorate per lb.	5d. to 5½d.	..
a „ Perchlorate „	6d.	..
a Shellac per cwt	£16 14s.	..
a Sulphur, Sublimed Flowers „	£14 10s.	..
a „ Lump „	£13 1s.	..
a Soda, Chlorate per lb.	8½d.	..
a „ Crystals per ton	£7	..
a Sodium Bichromate, casks per lb.	6½d.	..
METALS, &c.		
p Babbitt's Metal and Anti-friction Metal—		
Grade I per ton net	£160	..
Grade II „ „	£118	..
Grade III „ „	£71	..
c Brass (rolled metal 2" to 12" basis) per lb.	10½d.	½d. dec.
c „ Tubes (solid drawn) „	1/0½ to 1/0½	..
c „ Wire, basis „	10½d.	½d. dec.
c Copper Tubes (solid drawn) „	1/-½	..
c „ Bars (best selected) per ton	£98	..
c „ Sheet „	£98	..
c „ Rod „	£98	..
d „ (Electrolytic) Bars „	£73 10s.	35/- dec.
d „ „ Sheets „	£145 10s.	..
d „ „ Wire Rods „	£90	25/ dec.
d „ „ H.C. Wire per lb.	11 1/16d.	½d. dec.
f Ebonite Rod „	3/6	..
f „ Sheet „	3/-	..
g German Silver Wire „	2/0	..
h Gutta-percha, fine „	12/6	..
h India-rubber, Para fine „	1/1½	1½d. dec.
i Iron Pig (Cleveland Warrants) per ton	Nom.	..
l „ Wire, galv. No. 8, P.O. qual. „	£27	..
g Lead, English Pig „	£26	..
g Mercury per bot.	£10 10s.	..
e Mica (in original cases) small per lb.	3d. to 3/-	..
e „ „ „ medium „	4/- to 8/-	..
e „ „ „ large „	10/- to 20/- & up	..
p Phosphor Bronze, plain castings	1/2	..
p „ „ drawn bars and rods „	1/4½	½d. dec.
p „ „ rolled strip & sheet „	1/4½	½d. dec.
p „ „ Wire „	1/4	½d dec.
d Silicium Bronze Wire per lb.	1/2½	½d. dec.
r Steel, Magnet, in bars „	1/-	..
n Tin, Block (English) per ton	£164 to £164 10s.	£8 dec.
n „ Wire, Nos. 1 to 18 per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

United States Electric Vehicle Market.—The demand for electrically-driven passenger cars shows no improvement, and manufacturers of these vehicles are non-committal in their views with regard to the future. Electric truck manufacturers state that business is improving, although opinions naturally vary as to the extent of the improvement, but all are of the opinion that the prospects for the electric truck industry were never brighter than they are to-day.

Manufacturers and others actively interested in the electric vehicle industry held the first of a series of monthly meetings on December 2nd. Mr. James H. McGraw, president of the New York Electrical League, was one of the principal speakers. He said, in part: "With a growing appreciation of the service achievements and possibilities of the electric truck, we are facing a new era. The time is coming when, for package delivery, the horse will quickly disappear from our streets and the gasoline truck will have to fight hard to maintain its existence. Last year their increase in the use of electric trucks in New York City alone was more than 400 per cent., and the use of electrically-propelled vehicles is also greatly increasing in cities like Chicago, Boston, Philadelphia, Cleveland, and Detroit."

No definite date has yet been fixed for the electric vehicle show to be held in New York City early next spring, but it is probable that the exhibition will open in March or April. Leaders in the industry will hold a meeting on January 13th, when the proposal to publish a journal devoted exclusively to electric vehicles will be discussed. The project is said to be widely approved.—*Reuter's Trade Service* (New York).

The Oil Turbine.—In reviewing the past year's progress, the engineering correspondent of the *Daily Telegraph* states that some success has attended the efforts of Messrs. Thyssen, of Mullheim, in the development of the oil turbine, by using specially-treated electric-steel blades.

THE MANUFACTURE OF CARBON ELECTRODES.

[Communicated.]

The carbon electrode industry started about forty years ago, and the credit for its earlier developments belongs chiefly to the Frenchman, Carré. He was the first to institute grinding of the raw material, mixing with a binding agent, pressing into moulds and afterwards heating the moulded shapes to incandescence. Carré's methods, with modification in manipulative details, and with various new materials, are still being employed.

The earlier carbons manufactured were principally for electric illumination, but later they began to be employed in electro-metallurgical work. Electric resistance as a source of heat was gradually adopted for the production of aluminium, calcium carbide, and ferro-alloys, as well as for electric steel, and the production of electrodes for electro-metallurgical work has become a very important industry. The requirements of the metallurgical industries demand a quality of electrode quite different from the requirements for obtaining a steady arc in electric lighting. The principal qualities which are essential are great magnetic strength and conductivity, with a minimum of loss. The dimensions are now of such magnitude that the mechanical strength required to permit the necessary handling is also a point of great importance. The consumption of carbon electrodes is now on such a scale that the larger manufacturing firms require plants comparable in size to the largest ceramic kiln installations. The machinery employed is of considerable size, particularly the hydraulic presses used for making the larger types of electrodes.

Information regarding the processes in use has been obtained partly from the respective makers, and partly from the published literature of the subject.

In general, the process consists of mixing the ground and cleaned raw material with tar or tar-like substances, giving it the desired shape by pressing, and finally calcining the pressed shapes to give them the required mechanical strength and electrical conductivity.

In principle this appears exceedingly simple, and is closely related to the general methods of the ceramic industry. As a matter of fact, a large amount of skill and experience is necessary to produce a satisfactory product, and it is said that even the most experienced makers occasionally meet with failure in obtaining the right conditions.

The raw materials considered suitable for the manufacture of electrodes include all varieties of carbon found in sufficient purity and in a form which can be used industrially. The list comprises coke, charcoal, anthracite, lamp black, retort carbon, petroleum coke, and graphite. The proportioning of the quantities of the different ingredients, and the size of grain, are of paramount importance in arriving at the desired quality of the final product. The manufacture begins at the crushing of the raw material when this is necessary. As most of the substances used are quite hard, substantial crushing machinery is essential, and the equipment must include the necessary appliances for obtaining the correct grade of fineness. Abraded iron from the crushing machinery is objectionable, and means must be employed to exclude it from the ground product. The crushed material is calcined to drive off occluded gases and to destroy oily substances, and it is then mixed with the binding medium—tar or pitch—and thoroughly kneaded. The mixture is then ready for the press, where it is given the desired shape, and its density is increased. After an interval, which may be hours or even days, the pressed shapes are subjected to a coking process in a gas-fired kiln, with exclusion of air. The air is excluded by placing the electrodes into square or round chambers made of highly refractory material and packing them round with carbon powder to fill the spaces between them and the wall of the chamber. Air-tight covers are provided to the chambers, and these have a small opening through which the vapour given off in the heating escapes. The furnaces are low and constructed of refractory material to withstand temperatures round 1,500 or 1,600 deg. C. The period of calcination varies according to the dimensions of the electrodes, being from ten to sixteen days for the larger sizes. The firing must be carefully regulated to avoid stresses being set up in the electrodes which might lead to cracking, and thus oil-fired kilns are preferable. During the early stages of this operation, the tar oils in the binding medium are distilled off. This is usually complete after a red heat is reached, and then the temperature may be increased until the binding medium cokes, and finally the whole mass begins to fuse. The finished electrodes are removed from the furnace, and after cooling are examined for cracks or other faults.

A German firm supplies the following details regarding the physical and chemical qualities of the electrodes made by it:—Specific weight, 1.50 to 1.55. Specific resistance at cross sections of from 30 to 3,000 sq. cm. 45 to 100 ohms. Electric co-efficient, at temperatures from 25 to 900 deg. C., 0.18 to 0.22. Compressive strength, 230 to 410 kg. per sq. cm. Bending strength, 51 to 81 kg. per sq. cm. Ash content, 2.5 to 3.0 per cent.; phosphorus, 0.45 to 0.53 per cent.; sulphur, 0.93 to 1.10 per cent.

The process of the Soc. An. Electrométallurgique (Procédés Paul Girod), Ugine, is as follows:—The principal raw products used are retort carbon, petroleum coke, and anthracite. Pitch is used as the binding medium. These raw materials are used either separately or mixed in certain proportions, their selection depending upon the cost of production. Retort carbon comes, as is well known, from obstructions formed in the retorts of gas plants. The ash varies from 1 to 3 per cent., and the volatile portion is small. After its incineration, only small traces of ash are found, and consequently the material can be used directly for the manufacture of electrodes without preliminary treatment. Analysis of retort carbon is approximately, in percentages:—Ash, 1.77; volatiles, 0.46; sulphur, 0.73.

Petroleum coke is considerably different from retort carbon and requires a preliminary treatment before it can be mixed with the binding medium. Petroleum coke is a residue obtained from the distillation of heavy or petroleum oils, and still contains from 5 to 8 per cent. of volatile substances. To remove these, the material is distilled in furnaces with horizontal retorts similar in construction to the ovens used in gas plants. Petroleum coke is heated in these retorts for about six hours at a temperature of 1,000 deg. C., after which it contains about 2 per cent. of ash. In addition to this supplementary distillation, the material is subjected to a preliminary washing for the purpose of removing any soluble salt it may contain.

Anthracite is treated in much the same way, as it also contains volatile matter. Its ash content is about 2 per cent. if properly selected. Anthracite with appreciable quantities of iron oxide is to be avoided. The composition of a suitable sample is in percentages approximately as follows:—Ash, 2.77; volatile substances, 6.30; sulphur, 0.79; phosphorus, 0.032; iron oxide, 0.27. After the volatile matter has been removed by distillation the material is passed through the crushing and grinding plant and broken into grains of a size between 2 and 3 mm. It is then packed into sacks and weighed, and is then ready to be used. The tar, which serves as a binding medium, is a mixture of pitch and tar oil, the quantity ratio of which must be strictly maintained. It usually has the following percentage composition:—Ash, 0.15; volatiles, 43.0; carbon, 56.85. The composition of the tar is determined not only chemically, but its viscosity is ascertained by observing the time required by a measured quantity to pass through an aperture of a given size. The quan-

tity of tar used varies from 22 to 30 per cent., depending upon whether the subsequent operation is to be a pressing one or squirting by a special process to form the desired shapes. The mixing is carried out in steam-jacketed mixing machines, and when it is thoroughly mixed it is further worked in mills to increase the density. It is then pressed into moulds, or if the squirting process is to be used, it receives a preliminary pressing, and is then transferred to a second press, where it is moulded under pressure of from 380 to 450 kg. per sq. in.

The extruded blocks will furnish from four to eight electrodes of the required diameter. After leaving the press the electrodes are placed vertically in an annular kiln, where they are embedded in coke dust in special earthenware vessels and baked. The tar binding medium becomes coked, and forms the matrix in which the original anthracite grains are embedded. The kiln consists of thirty chambers, each with six vessels. It is heated with producer gas, and is maintained at a temperature of from 1,100 to 1,250 deg. C. It is particularly important that the heating of the chambers be regular and progress uniformly, and equal care must be given to the cooling. Any deviation from this rule results in failure. After removal from the kiln, the electrodes are brushed clean and examined. They should show no cracks, and when tapped with a hammer should give out a clear ringing sound. A number of the electrodes from each batch are tested for electrical resistance, for which special plant is provided. The electrical resistance must not exceed 400 ohms per sq. mm. for each metre in length, with the heaviest pieces.

The practice at the electrode factory of Dr. Albert Lessing, at Nurnberg, is to use retort carbon as the raw material. The extrusion method is used for shaping the electrodes, and in other respects the methods adopted are similar to those already described.

At the British Aluminium Company's factory at Greenock, in Scotland, the practice is also much the same, the raw material in this case being petroleum coke. The operations may be summarised as follows:—(1) Petroleum coke is baked to remove all volatile substances and to increase its density and conductivity. (2) The roasted material is crushed to the desired grain size. (3) The prepared material is mixed with pitch and desiccated coal tar in a steam-heated mixer. (4) The mixture is shaped into the desired form by the use of moulds and hydraulic presses. (5) The shaped pieces are baked in kilns heated by the combustion of producer gas for five days. (6) The baked electrodes are carefully cooled, brushed clean from adherent carbon, and placed in the warehouse ready to be issued for use.

The preparation of the petroleum coke contains some features of interest. The petroleum coke contains from 5 to 13 per cent. of volatile hydro-carbons. It contains also about 2 per cent. of inorganic matter. This material is usually supplied from the oil-refining factories in large pieces, which is an advantage. Small coke and dust clog the roasting kilns, and can only be utilised in the charge in small proportions. The kilns are vertical, and the coke is charged in at the top and the baked material removed at the bottom, thus permitting continuous operation. Charging is done every two hours, and every half-hour a portion is removed from the bottom. The coke requires five hours to pass from the throat of the furnace to the bottom, and the temperature at the hottest part of the kiln reaches about 2,000 deg. C. The process is expensive, as about 40 per cent. of the charge is consumed. The volatile portion being about 8 per cent., there is thus consumed about 22 per cent. of the fixed carbon in providing the necessary heat. To some extent roasting is also carried out in horizontal retorts, the first cost of which is greater, but which are more economical in use. The temperature required is about 1,000 deg. C., and is, therefore, about half that used for vertical furnaces. The composition of the baked material averages in percentages: Silica, 0.50; ferric oxide and alumina, 0.15; soluble sodium salt, 0.05. The product is then crushed to pass a 95 screen, after which it is ground to the grain size required. This grinding is of the greatest importance, as the quantity of fine and coarse grain powder must be in suitable proportion so as to form blocks of the required density and of little porosity. The following is a satisfactory mixture:—40 per cent. screened through 100 mesh; 15 per cent. through 60 mesh; 20 per cent. through 30 mesh; 15 per cent. through 16 mesh; and 10 per cent. through 8 to 16 mesh. The crushing is done in stone crushers and rapid-running vertical mills. The cost of crushing is from 3s. to 4s. per ton. The electrode stumps from the aluminium works are also used up again, and retort carbon is sometimes used. It is interesting to note that when these are crushed to the requisite grain size, a large proportion of the inorganic matter they contain is removed in the fines, leaving for use a much purer material than the original.

Graphite electrodes are now often used, but the initial material is not usually the natural graphite. They are more usually made by the use of amorphous carbon and afterwards graphitised by treatment in an electric furnace.

"KILLING THE GOOSE."

By "A LAMP TRAVELLER."

Keeping the ring lamps going nowadays is an art for diplomats—of the Le Queux type, I mean—strong, silent men with silvery tongues, able to talk by the day to their victims with one hand, while purloining plans and documents with the other.

We have to do all these things and several more at the same time to get orders, and then do not get them more often than not.

To come to business. The lamp ring organisation and method of controlling price right down the grades till the lamp—somewhat paw-marked by the many fists that have handled it—actually reaches the user, is perfect in theory, and would be in practice if no one ever told a lie and there were no other lamps to be got.

As matters actually work out, the Ring is kept alive by its customers ignoring completely its elaborate grading system, and risking the penalties it dare not enforce.

The traveller whose business it is to sell ring lamps would never book anything but expenses if he consistently refused to go beyond the contractor's graded discount.

For instance, Truthful James, of the George Washington Electric Supplies Co., Ltd., will call on his friend, Mr. Twistem, electrical contractor, removals by the hour, day or job, plumbing and mangling done here, for a lamp order, having first ascertained that he is graded at 24 per cent.

"Good morning, Mr. Twistem, how are you, and how is Mrs. Twistem?" Consider that suitable replies, adjusted to Mr. T.'s bachelordom, have been made, and now business commences. "How about your lamp stock for this winter, Mr. T.; I see you haven't ordered it yet; we'd like a few more orders like your last autumn ones, ha-ha!" For some reason James thinks this facetious. T., who has the major part of that lot still on his shelves, doesn't see it.

"Well!" he grunts, if James is lucky, "I *am* wanting a dozen two-hundred-volt, forty-watt, half-watts."

"Ah! thank you very much, Mr. Twistem." James whips out a premature note-book and gets the order down quick.

"You're graded twenty-four per cent., I see," he remarks, conversationally. "Now, how about lampholders, flex, tumbler sw——"; but T. has got his breath back.

"Twenty-four per cent.! did you say twenty-four per cent.? *Why, my customers want that.*"

He tears a document savagely off a savage spike, and forces it on James.

"There, young man, I want a bit more than that if you want the order."

James, sick at—the usual place—casts his eye over it; he has seen something like this before. As he fears, it is an invoice from the G. Washington Co.'s deadliest competitor, Ananias & Co., for a dozen two-hundred-volt, half-watt ring lamps, "discount 35 per cent."

James knows that his firm has signed an agreement not to sell to contractors at more than their graded discounts, and also realises that he *is* the firm to the man whose order he wants.

What a subject for a film drama: sub-title "(Commercial) Death or (his firm's) Dishonour."

James doesn't care about commercial death, and with mental pictures of the firm's lamp-laden shelves and the governor's instructions, emphasised by dancing inkpots, "Sell lamps, any darned how, but SELL THEM," he offers thirty-six per cent., which is accepted. True, it is about as much as the firm gets, but stock *must* go, he knows.

Unless his firm happen to be of the dare-devil type, careless of Ring wrath, they will have to send a credit for fictitious returns to make up the difference between the real and authorised discounts, and the invoice clerk always sheds tears of joy when working out fractions of lamps.

James, having booked the order again, recommences his patter re lampholders, flex, tumbler sw——when in walks a lady customer from the country, who asks for three thirty-volt, fifty-candle-power electrical globes, please.

"I sold the last one not an hour ago," says T., who hasn't seen one for months, "but I've got some coming first thing to-morrow morning"—he winks a wink at James that means "have you got them in stock?" and James nods a nod that T. thinks means "yes." It means really that the G. Washington odd boy will have to chase round for them to-morrow, but James daren't refuse an order, and the customer will be lucky to get them in a week.

"—and I'll see you get them before 12 o'clock, madam," continues T.

"How much will they be?" "Four and six each, madam."

"Oh, *dear* no, I can get them for four shillings from Mr. Filing."

"Very well, madam, I'll make it four shillings, then—and God help you next time your automatic plant wants a rest," says the helpless T. (you can pick out the stage aside), who is bound by horrible oaths not to sell lamps under list price.

You see they all get it, factors and contractors—brothers in misfortune.

It may seem to those not quite in the know that the idea of a wholesale merchant accepting the minute orders mentioned is absurd. Try them and see

What a glorious day it will be when real competition again infuses vigour into our trade.

Then it will be possible for us travellers to offer some other advantage beyond our personal charms as an inducement to buy, without perjury; and some of us semi-bald elderly men will no longer have to bear the agony—as I have—of watching a lady lamp traveller gazing with liquid eyes into the fatuous countenance of a contractor—and making him thirsty with her liquid breath—while wheedling MY orders out of him.

ARGENTINA: A REVIVING MARKET.

AFTER weighing carefully the prospects of Argentina's future trade, in the light of happenings during and since the war, H.M. Commercial Secretary at Buenos Aires remains convinced that the position is thoroughly healthy.

He admits that the prospect of improvement is not immediate, but from past experience and existing conditions he sees reasons to indicate that the present depression will prove temporary.

The economic strength of Argentina is represented by abundant stocks of foodstuffs and raw materials, which are needed by the principal consuming countries, by a sound currency that has not been affected by inflation, and by no present appearance that the exportable surplus of her many staples will diminish during the forthcoming season.

Encouraging Conditions.

Important factors regarding the possibility of British competition are the circumstances that excessive stocks are in process of liquidation and re-shipment; that there is a premium of 50 per cent. on the United States exchange, which operates as an equivalent premium on exports to that country, and as a restriction of imports of merchandise to minimum requirements; and, finally, that importers have had sufficient experience of the vagaries of losses on exchange to be alive to the necessity of avoiding further speculation.

The Argentine market maintains its preference for British goods and British methods. This preference is based on experience, quality of goods, investment of capital, and reciprocity of trade. From long experience of trade with Argentina, British exporters and local British houses have become familiar with Argentine requirements and with the best methods of doing business, and they have found in Argentine merchants a readiness to assimilate British business ideas. The strongest features of the British trade connection with Argentina are the large number of enterprises established by British capital and of British firms engaged in business in the country, and the constant interchange of visits which these mutual interests entail.

It is a hopeful message which Mr. Chalkley sends, that "Both German competition before the war and American competition during and after the war confirmed the general soundness of British methods." The advice applicable is, therefore, that these methods should be constantly developed and perfected, and that new firms entering the market should study and copy them. Endorsement of this official optimism is furnished by an Argentine economist, who says: "The recovery of the United Kingdom is evident from commercial statistics, and justifies the conjecture that the British will resume the first place in Argentine commerce, which they held uninterruptedly for so many years. This conclusion is strengthened by past experience of British commerce, which was always characterised by fair and unequivocal dealings, and always appreciated in Argentine commercial circles for the worth and excellence of its products."

Price Factor.

It would be misleading, the report continues, to give the impression that the preference for British goods and the established position of British trade are in themselves sufficient to secure orders. These advantages are subordinate to the vital factor of competitive prices, and even where British prices can compete with those of foreign merchandise they would be dissipated by inactivity. It is necessary to maintain them by enterprise and constant vigilance. Buenos Aires is a keen international market-place, where the products of all manufacturing countries are offered on the spot by competent representatives. Argentine buyers, or rather the buyers of the Buenos Aires importing firms of all nationalities, for the Argentines themselves are not much addicted to trade, are well posted on the values of merchandise, as they can compare qualities and prices offered from the United Kingdom, France, Germany, Italy, Spain, United States, and even Japan. The buyer visiting Europe does not, like the Colonial buyer, go direct to the United Kingdom, but probably makes his headquarters at Paris as a convenient centre from which to visit Spain, Italy, Germany, and the United Kingdom.

It is believed in Buenos Aires that representatives of German factories have been too ready in entering into engagements, and certainly in making offers with which they are finding difficulties in complying; and further, that the qualities of German materials are giving rise to complaints and rejection.

That the renewed activity of German competition is important is, however, clear from the actual arrivals of German goods. From June 1st to June 30th, 1921, no fewer than 65 ships arrived at Buenos Aires from German ports of 214,382 register tonnage, compared with 38 ships of 117,386 tonnage during the preceding six months.

All these ships were well loaded with German merchandise, including such goods as steel wire, iron bars and pipes, brass tubes, zinc sheets, tinware, aluminium goods, wire netting, heavy machinery of various descriptions, spare parts, electric motors and supplies, light railway material, typewriters, optical and surgical instruments, dental and pharmaceutical supplies, hardware, tools, cutlery, enamel ware, heavy chemicals, porcelain, crockery, rubber goods, woollen, cotton and silk goods, newsprint, toys, kinematograph films, drugs, aniline dyes, pianos, musical instruments, paper, cardboard and cement. In practically all tenders for Government contracts during 1921 German quotations were so abnormally low as to exclude competition from other countries. Such tenders

were for rolling stock, railway material, steel bridge work, boring tubes, electrical generating plant, cranes, drainage pipes, pumping machinery, &c. In all such tenders, as a rule, several German firms participated with varying quotations outnumbering all representatives of other countries together. It is yet too early to judge how far the present abnormal conditions of German competition are likely to continue in view of the artificial financial basis of German industry and foreign trade, the instability of German exchange, the unknown productive capacity of German factories, and the extent to which Germany will require to import raw material for expansion of industry.

Local Industries. Of particular interest to the British exporter is the movement towards local manufacture in Argentina. The effect of the commercial depression on local manufacturing industries proper has been rather to arrest their activities for the time being than to cause any serious setback or closing down, with the exception of the quebracho extract factories which produce for export. The opportunities of the war were not used to create any new industrial enterprises on a large scale, but rather led to the expansion of those already in existence. The difficulties of securing, and the ascending prices of, industrial machinery during and immediately after the war proved a barrier to equipping new factories. The subsequent break in prices and resumption of foreign competition, therefore, found no victims in the shape of industries created on an artificial war basis. Heavy losses have been incurred by factories on their imports of material, in view of the movements of exchange and the fall in prices, but there have been no failures of importance. In the opinion of the Commercial Secretary Argentine industries will continue to expand on the same scale as before the war. Therefore the following table showing the position at the last census (1914) is instructive:—

Argentine Manufacturing Industries.

	Persons employed.
Metallurgical.—Mechanical and foundry work, agricultural implements and appliances, constructional steel, sheets, wire drawing and netting, nails, electrical fittings, metal shutters, ornamental ironwork, safes, tin-working enamelled hollow-ware	23,938
Building Material.—Bricks, mechanical carpentry, cement, tiles, stone working	23,807
Furniture.—Household furniture, vehicles, motor bodies, bedsteads, mattresses, basket and brushware...	22,971
Leather.—Boots and shoes, tanning, harness and saddlery, leather goods	21,840
Foodstuffs.—Confectionery, mineral waters, alimentary pastes, ice, beer, edible oils	20,144
Textiles.—Knitted goods, woollen fabrics, blankets, hats, woollen yarns, jute bags, rope-soled canvas shoes	19,620
Tobacco.—Cigarettes, cigars, tobaccos	7,121
Miscellaneous.—Matches, paper and cardboard, glassware, soaps and candles, heavy chemicals	10,542

Imports of Metal Manufactures. An appendix to Mr. Chalkey's report gives the values in gold pesos (5.04 = £1) of Argentine imports during the first six months of this year compared with the full year 1919. Argentine statistics of import values in general are based on valuations fixed in 1906 for the purpose of assessing import duties, but the following statistics are the estimated real values of imports:—

	1919. pesos gold.	1920. (six months) pesos gold.
Electrical Machinery and Materials	9,078,858	5,001,148
Iron and Steel.		
Raw and partly manufactured; galvanised iron, pig and sheet iron, wire, nails, girders, steel bars and sheets	37,872,117	22,699,108
Manufactured: machinery, motor-cars, rails, tools and all other manufactures of iron and steel ...	29,708,314	34,261,623
Total	67,580,431	56,960,731
Non-Ferrous Metals.		
Tinplate, copper, lead, zinc and partly manufactured products ...	12,626,273	2,595,749
Manufactured: jewellery, watches, and clocks, electroplate, lighting fixtures, cartridges	11,800,791	9,175,081
Total	24,427,064	11,770,830

Cable Manufacture in Finland.—The new workshops of the Finska Kabelfabriken A.B., which was formed in the autumn of 1916, have now been brought into use in Helsingfors. The production is undertaken of all kinds of vulcanised conductors, as well as of large cables for power purposes. A complete rubber department has been established for the production of insulating material direct from raw rubber, and the wire-drawing plant has an output capacity of 1,000 tons per annum.

GAS *versus* ELECTRICITY.

Another debate between representatives of the gas and electrical industries upon the merits of their respective agents in various fields, took place at Chelmsford on January 5th, under the auspices of the Chelmsford Engineering Society, an active and progressive body of technical men, mainly from the local engineering works. The Society's president, Mr. G. F. Barrett, O.B.E., occupied the chair, and the principal speakers were Mr. W. H. Becket (gas), and Mr. C. S. Buyers, M.I.E.E., of Messrs. Crompton's. For the "gas" side circulars were distributed to those present, containing a report upon comparative cooking tests carried out between Mr. Belling and the British Commercial Gas Association, using electricity and gas. As may be gathered from the source of distribution, this favoured gas cooking.

Mr. Becket opened the debate by reading some notes prepared by Mr. H. H. Creasy. The speaker agreed that there was a huge field for the inventiveness of electrical experts, but he could not agree that this field included cooking, heating, and water heating, in which gas was superior. Electrical engineers always laid stress upon the great improvements which were being or would be made in their appliances, but ignored the fact that the manufacture of gas and gas appliances would also improve and indeed was improving. Electricity was not likely to make greater progress than gas and as a heating agent it had less room for progress. More than thirty years ago we were told that gas was doomed; electric light had appeared in Fleet Street and Regent Street; to-day both were again lighted by gas, as was also Whitehall, spoken of as the best lighted thoroughfare in the world. Chelmsford once had electric lighting, but this had been replaced by gas. Mr. Becket deprecated the statement that gas was detrimental to health, and poured scorn on the suggestion that there was less wastage of meat in electrical cooking. That the case thus presented for electricity was not sound was borne out by the progress made by the gas industry; in the last six years output had increased by 5,176 million cu. ft., and in eighteen years by 9,630 cu. ft., a 44 per cent. increase in a business 100 years old. Contrary to the opinions of electrical men, the health of London had improved with this increase of gas consumption. Regarding continuity of supply, gas was far superior. He would ignore small breakdowns, but was compelled to speak of the breakdowns of electrical supplies which plunged large districts into darkness and robbed them of motive power. The Gas Light & Coke Co. had maintained an unbroken supply through wars and strikes for over 100 years, and any serious breakdown of a town's gas supply was practically unknown. What were the facts regarding electricity supply? Mr. Becket then read a number of extracts from newspapers giving accounts of recent large failures in electricity supply, two of which were due to fire. Turning to lighting, the speaker admitted that gas lighting had to face strong competition from electricity, and for certain applications electricity could not be challenged. For street lighting and outside shop lamps it was a matter of comparative prices in particular districts. The gas industry could produce lamps of the highest candle power ever likely to be needed, and maintenance charges were usually lower for gas than for electricity. For factories, inside shops, and general residential lighting gas compared very favourably as regarded installation, running and maintenance costs. For working-class houses gas was still supreme and less costly in all respects; in new housing schemes gas lighting predominated. The speaker then gave figures of the comparative costs of gas and electric lighting. These were held to prove that with electricity costing 10d. per unit, illuminating a tungsten lamp, the cost of gas to provide an equivalent number of c.p. hours would be at the enormous price of from 23s. 4d. to 31s. 8d. per 1,000 cubic feet according to pressure and the type of burner. Comparing gas with the gas-filled lamp, the figure would be from 12s. 1d. to 26s. 8d. But gas was only 5s. 7d. per 1,000, and electricity was 1s. per unit. In the provision of hot water electricity did not count; gas was infinitely more rapid, economical and reliable. The number of B.th.u.'s electricity could provide for a given sum of money was always exceedingly low compared with the quantity given by gas for the same money. Mr. Becket took Chelmsford as an example, with gas at 5s. 7d. per 1,000 cubic feet and electricity at 4½d. per unit, and showed that on the B.th.u. basis electricity was 9¾ times as costly as gas, and at the best, if it was 2½d. per unit, 4½ times as costly. Electricity could not even "top up" successfully. An example was quoted of a restaurant which installed a coke-boiler system "topped up" by electricity, side by side with a gas water-heating system. The proprietors were compelled to scrap the former on account of cost. For industrial processes gas was in greater demand than electricity because flame contact played an important part in most processes. Electricity was certainly supreme in spot welding, and the flame arc was also widely used. For warming rooms gas fires

were economic, hygienic, and pleasing to the eye. To get 100 per cent. efficiency from an electric heater it had to be placed in the centre of a room, which interfered with proper ventilation. Gas fires placed in a fireplace assisted ventilation. The chimney was one of the best sources of ventilation, and yet electricians were advocating its omission. We were constantly being told that electric cookers were improving. It was a case of "jam to-morrow and never jam to-day." A point against electric cookers was the inability to move them from one place to another on account of local differences in electricity supply. The maintenance costs of gas cookers were very low compared with electrical appliances, which needed new elements very frequently. The speaker mentioned the case of a gas ring which had been in use for over 20 years and was as good as ever. The initial cost was also against electric cookers. Mr. Becket concluded by saying that both gas and electricity had their respective fields, and electrical engineers shoul dabandon unprofitable competition and concentrate upon business in which they could succeed, instead of making more or less acrimonious attacks upon the gas industry, which was like the beast mentioned by, he thought, Mark Twain, "A very vicious animal; it defends itself when attacked."

Mr. C. S. BUYERS, M.I.E.E., opening the case for electricity, first dealt with lighting, and traced the development of the electric lamp and its growing efficiency. Electric lighting was efficient, strong and clean; it caused no discoloration of wall-papers and ceilings; it had no noxious fumes or singing noises. A great advantage was the ease with which it was switched on and off. Economy and convenience could be obtained by double switching. Prices of gas and electric lighting varied in nearly every town; with gas at 5s. 6d. per 1,000 cu. ft. and electricity at 1s. per unit, costs were not very different, but it had been shown in practice that the public preferred electric lighting. The candle power of gas mantles fell off considerably after the first hundred hours or so, but in a life of 1,000 hours the electric lamp retained at least 90 per cent. of its candle power. Electric lighting had added to the value of basement premises. Shopkeepers would rather pay a higher price for electricity than return to gas lighting; the absence of fire risk was a great asset. The maintenance costs of gas lighting were often very high. For trains electric light was excellent but the cost of changing over from the older systems had militated against the conversion. The flame arc had been found ideal for lighting main streets of cities, and the gasfilled lamp was also becoming popular for this purpose. Electricity found a wide field in kinema studios, searchlights, ship-lighting, art-gallery lighting, &c., and these were but a few of the instances in which it was unrivalled as an illuminant. The power aspect could be considered under three heads:—Suitability, relative costs, and relative advantages. There were so many instances in which the employment of a gas engine was out of the question, that suitability was the first consideration. In the collieries of this country electric motors totalling 600,000 h.p. were used underground for many purposes. The duties of the electricians, at these places were chiefly supervisory, the motors actually being in the charge of non-technical workers. Gas engines could not, of course, be used underground. Overhead cranes were driven by electric motors; the d.c. series motor was generally used as its speed varied inversely as the load. The control of these machines was very sensitive. Another application of the electric motor was to passenger lifts. Gas engines had been employed for this purpose, but the controlling and reversing gear was cumbersome. In the domestic establishment fractional-h.p. motors were used for fans, vacuum cleaners, &c. The portability of the electric motor made it invaluable in shipyard work. The gas engine was too noisy to install in a residential district, but the electric motor ran silently. The prime cost of a gas engine was several times that of an equivalent electric motor. The gas engine required expensive concrete foundations and also space for the cooling tanks. The electric motor was usually supplied with slide rails which could be bolted down on an existing floor; and only very large motors required special foundations. Where fluctuating loads were dealt with a gas engine of 35 h.p. would be required to perform the same work as a 28-h.p. electric motor owing to the latter's ability to sustain heavy loads for an appreciable space of time. The gas engine certainly would take a small momentary overload owing to the stored energy in its flywheel, but if subjected to this too long it would slow down and stop. It was incorrect to simply take the fuel costs per h.p.-hour developed when comparing the two. Consideration should be given to capital charges, renewals, lubrication and labour costs. This, as a rule gave a result very favourable to the electric motor. A characteristic of the electric motor was the ease of control of all sizes from 1/10 to 10,000 h.p. The motor took up little space and generally could be fixed in any desired position. Since 1914 the installed h.p. of electric motors had more than doubled and the increase was being maintained. Even in gas works motors were more in evidence than gas engines. Other applications of electric power were lifting magnets, welding, and furnaces for producing special steel. Coming to heating and cooking, Mr. Buyers said that it was here that the keenest competition was found. Upon consideration it would be found that the number of gas cookers in use was due to:— Persistent and successful propaganda work; the hiring, installing, and maintenance of apparatus at nominal sums, or even free of cost; and attractive tariffs and slot meters. The disadvantages of cooking by gas were the detrimental effect upon health of the fumes; the lack of pressure at the most critical times of the day; and the risk of scorching food owing to the lack of proper control. These were absent from the electric cooker. Supply authorities were handicapped by legislation, and it was only in 1920 that municipal authorities were given power to hire out electrical apparatus. This was being taken advantage of, and the speaker quoted the example of the Glasgow Corporation. If electricity could be obtained for 1d. per unit, the average cost of cooking per week would not be more than 3s. 6d., but even if the price was 1½d. or 2d. the cost would not be exorbitant considering the advantages of electric cooking. Mr. Buyers outlined schemes for three classes of houses—working-class, larger dwellings, and mansions, where central heating was commonly found—and showed how it was possible to combine coal and electric heating. As appliances became cheaper coal would gradually be replaced. The portability of the electric radiator, he said, was its greatest asset. As the heating and cooking load grew prices for electricity would be reduced. Mr. Buyers referred to Sir Dugald Clerk's figures setting out to prove that the substitution of electricity for gas would accelerate the depletion of our coal resources. While admitting that power station efficiencies were low compared with those of gasworks, Mr. Buyers insisted that the number of useful B.th.u. at the consumer's apparatus was the correct standard of comparison. In conclusion, the speaker pointed out the enormous saving of coal which would be effected by the electrification of railways. He ended with an appeal for cheaper electricity.

MR. W. M. MASON, speaking for the gas industry, said it was a national disaster that gas and electricity did not work together, as both were capable of good work in their respective spheres. There was no doubt that the best lighting in London was high-pressure gas lighting—electricity could not touch it. Gas for power was certainly not a back number, as a letter from a satisfied owner of a gas engine installed for 13 years, proved. He would like to ask how many of the electrical men at the meeting had electrical appliances in their houses. Had Mr. Buyers an electric cooker? The best advertisement for anything was the fact that it was used by those selling it. Mr. Buyers had spoken of Glasgow's electric cooker experiment—he must wait to hear from consumers when they had received their first quarter's bill. Mr. Mason quoted an extract from the Coal Conservation Committee's report in which gas was stated to be more desirable than electricity. Before concluding, the speaker said that electricity supply engineers admitted that the lighting load was unremunerative; but only millionaires could properly afford to install other appliances.

MR. FIELD (Messrs. Crompton's) queried the methods of obtaining the results given in the pamphlet distributed by the proponents of gas and thought that further details could be desired. Owing, no doubt, to lack of time, Mr. Becket had left the power question severely alone. For power gas could not possibly compete with electricity, and regarding coal conservation he thought that the Diesel power station took away a plank of the "gas" platform. In cooking and heating, the chief feature of electricity was its labour-saving properties. Referring to the quotations from the daily Press read by Mr. Becket, Mr. Field said that sensationalism was all that was sought. By not telling the whole truth the Press did electricity disservice. It was a tribute to the steadiness of electricity that no alternative had been considered necessary—otherwise there would have been no darkness.

The CHAIRMAN remarked that electrical power stations were more carefully designed than gasworks which were notoriously wasteful. He asked for information regarding the distribution losses of gas.

MR. SMITH (Manager, Chelmsford Gasworks) said that if a building was properly ventilated the products of gas production must escape and cannot be injurious.

MR. J. H. JOHNSON (Messrs. Crompton's) said it was of no use trying to prove the total pre-eminence of either gas or electricity. The convenience of electricity was its greatest asset, it was incorrect to compare calorific values alone. In such applications as textile mill drives where cleanliness was essential electric motors were ideal. Electricity had been throttled by legislation, but things were altering, and the gas industry would live and learn. The trouble regarding electric cooking was that it had outstripped normal evolution. He agreed that the cost of electric cookers was prohibitive, and if it were not so many more would be installed if only on account of their convenience.

MR. BEER (Chelmsford power station) said that the Chelmsford lighting had been referred to. This was not on a competitive basis at all—no one knew what it was costing the town. The change was due to a refusal of the supply company to reduce its charges. The result was to be seen in the present dismal condition of the town at night. Every house and shop on the company's cable route had installed electric light and appliances.

Messrs. Buyers and Becket briefly replied to points raised in the discussion.

SINGLE- AND THREE-PHASE A.C. COMMUTATOR MOTORS WITH SERIES AND SHUNT CHARACTERISTICS.

By S. PARKER SMITH, D.Sc., M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE fact that what takes place in the conductors between them is always reproduced at the commutator brushes, independently of the sense or speed of rotation, renders it possible to connect the field and armature windings in series or in parallel, although inductive effects may entail modifications when a.c. is used. In principle, then, the commutator motor—the action of which is independent of the speed—is eminently adapted for economical speed control and large starting torque, while in many cases a phase-advancement can be obtained in addition.

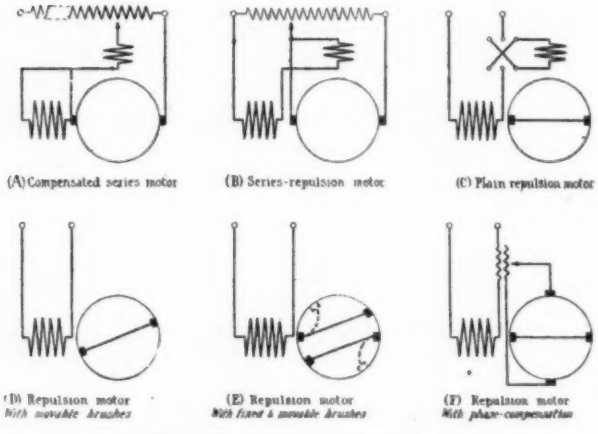


FIG. 1.—SINGLE-PHASE MOTORS WITH SERIES CHARACTERISTICS.

With a single machine, voltage control is impracticable with d.c., but practicable with a.c., because a variable-ratio transformer or other device can be used.

With field control the output remains constant over the whole speed-range. Consequently, a variable-speed d.c. motor must be designed for the full output at the lowest speed, while at all higher speeds the material cannot be efficiently utilised.

With voltage control, which is possible with a.c. motors, both field and armature current can be kept constant over the whole speed-range; therefore, a constant torque is maintained, and the output is proportional to the speed. This not only enables the material to be fully utilised over the whole working range, but corresponds more closely to the load characteristics of the majority of drives.

From a practical point of view the a.c. commutator motors unite most of the drawbacks of the d.c. motor with those of the induction motor. In addition, a worse evil, the transformer e.m.f. induced in the coils being short-circuited by the brushes, becomes one of the predominant factors in the design. From all these considerations, the air-gap has to be kept short, the armature reaction has to be compensated, and a low commutator voltage has to be employed, sometimes at the cost of a transformer.

The first mention of the fact that the series motor, when laminated, could work with a.c. was made by Alexander Siemens in 1884, at a meeting of the Society of Telegraph Engineers; while the polyphase commutator motor was patented by Ernest Wilson in 1888. About the same time Wightman in America discovered rotor excitation, and, in 1893, J. B. Atkinson, in his paper on "The Theory, Design and Working of Alternating-current Motors" before the Institution of Civil Engineers, showed how the single-phase commutator motor could be made to yield a shunt characteristic.

I. Some of the chief types of single-phase commutator motors with series characteristics are illustrated in fig. 1.

(A) The compensated series motor has ousted all other types as a single-phase traction motor. For this work it is usual to neutralise the transformer e.m.f. in the short-circuited coil, by means of a rotational e.m.f. induced by the flux produced by an interpole winding shunted by a resistance and excited by the main current. This gives the motor a very wide speed-range. The speed is controlled from rest by means of a variable-ratio transformer, a transformer being also necessary for reducing the supply voltage to the motor voltage. High power factor is obtained by designing the motor with a weak field and a strong armature magnetomotive force, by working well above synchronous speed, and by reducing inductive effects. On Continental single-phase railways inductive effects are reduced by adopting a frequency of 16⅔ periods per second. The compensating winding may be joined in series with the armature winding, or it may be short-circuited on itself. These motors have been built for outputs up to 3,000 h.p., while motors for 500 h.p. are quite common. About 40 to 80 h.p. per pole may be considered to be good design for large motors.

(B) The series-repulsion type has practically given place to type (A).

(C) In the plain repulsion motor the whole of the power is transferred inductively to the rotor, while the rotor voltage can be fixed independently of the stator voltage, so that no transformer is needed. At synchronous speed the transformer flux is correct for neutralising the inductive effects of the exciting flux on the short-circuited coils, so that the commutation conditions become similar to those in a d.c. machine. At other speeds, however, the magnitude of this flux is not correct, and the net result is that all motors of the repulsion type are ill-suited for wide speed-ranges.

(D) Combining the two stator windings in (C), the common repulsion motor with movable brushes is obtained. The brushes are in the short-circuited position when the brush axis coincides with the axis of the stator winding; and in the neutral position when the brush axis is perpendicular thereto. In both positions the torque is zero. Starting with the brushes in the neutral position no starter is required. The line voltage is applied to the stator winding, and the motor begins to revolve in the opposite direction to that in which the brushes are moved. Both transformer and starter can be dispensed with.

(E) By splitting the brushes into a fixed set and a movable set the brush shift is doubled, so that much finer speed regulation can be obtained. No flux embraces the short-circuited coils when the brushes are in the neutral position. Though not suitable for large variable-speed traction motors, types (C), (D) and (E) are admirably adapted for small and medium outputs for industrial purposes, with speed-ranges varying roughly from standstill to about 30 per cent. above synchronism.

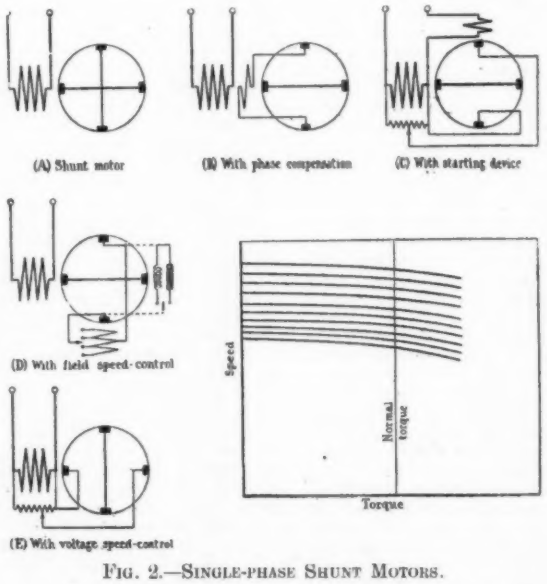


FIG. 2.—SINGLE-PHASE SHUNT MOTORS.

(F) Phase compensation is obtained by rotor excitation. The motor suffers from the necessity of working in the neighbourhood of synchronous speed, while the superiority of type (A) has ousted it, along with other competitors, from traction work.

Single-phase shunt motors are shown in fig. 2, and need two sets of brushes, the main and the exciting brushes.

(A) The plain shunt motor is decidedly inferior to the single-phase induction motor, for, in addition to possessing no starting torque, both efficiency and power factor are lower, and the motor runs merely at one speed, *i.e.*, synchronism. Some methods of overcoming these drawbacks are illustrated in fig. 2. (B) *Phase correction* is obtained by injecting a fraction of the applied pressure into the exciting circuit. (C) A large starting torque is obtained by letting the motor run up to speed as a repulsion motor. The machine can then be made to

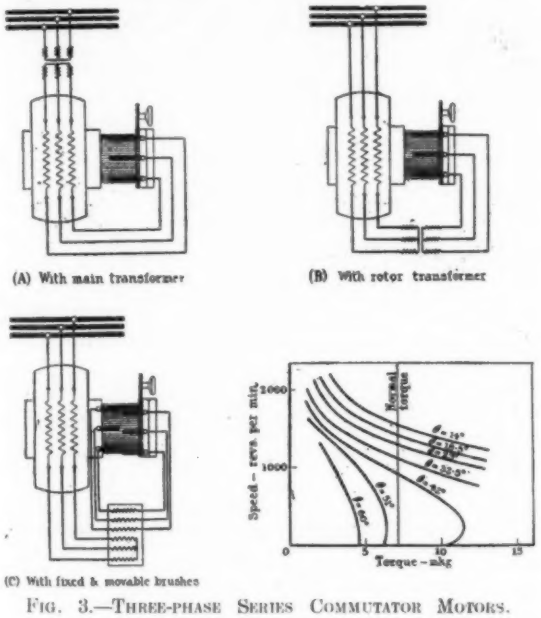


FIG. 3.—THREE-PHASE SERIES COMMUTATOR MOTORS.

run as a single-phase induction motor, but it is becoming common to combine (B) and (C) in order to obtain a constant speed single-phase motor with high power factor and large starting torque. (D) Speed regulation is obtained by varying the exciting flux—an inductance being used to raise the speed, and a capacity to lower it; or an auxiliary winding can be employed for this purpose. (E) In the doubly-fed type the speed is varied by regulating the pressure applied to the brushes in the transformer axis. This motor, the series-repulsion motor, and the three-phase commutator types belong to the general class of electrical machines in which energy is

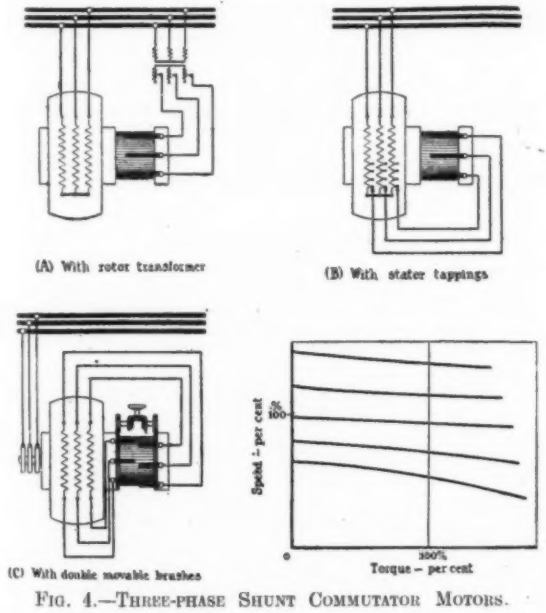


FIG. 4.—THREE-PHASE SHUNT COMMUTATOR MOTORS.

supplied to both stator and rotor, the power relations being definitely associated with synchronous speed.

II. The addition of the commutator to the rotor of the three-phase induction motor raises the frequency of the slip energy to the frequency of supply, and thereby enables this energy to be taken from, or returned to, the supply network, according to whether the speed is above or below synchronism. Thus, the motor range is not confined to sub-synchronous speeds, as is the induction motor. The limitation imposed in the speed-range of the three-phase commutator motor by the transformer e.m.f. induced in the short-circuited coils is similar in effect to that imposed on the repulsion motor; while the rotor is wound for equally low voltages.

The common method of controlling the speed of the three-phase series motor is by shifting the brushes. The direction of rotation depends on which side of the short-circuit axis the brushes lie, and is independent of the sense of the rotary field. When such a motor, with a fixed ratio of stator to rotor turns, is designed for a high-power factor, instability occurs at low speeds, as shown by the characteristic curves in fig. 3. It is usually necessary to provide a transformer to obtain the low rotor voltage. (A) A main transformer, rated for the full power of the motor, is usually necessary only for severe conditions. (B) A rotor transformer, rated for the slip power only, is all that is needed for many cases. By arranging that this transformer becomes saturated when the rotor voltage attains a certain value, *i.e.*, when a certain speed is reached, racing can be prevented. (C) Where stability over the whole speed-range and a high power factor are needed, the ratio of the stator to the rotor turns can be decreased, as the speed rises, by one-half of the brushes being fixed and the other half movable. The three-phase series motor is the simplest type of three-phase commutator motor.

The speed of the three-phase shunt motor is varied by supplying a pressure to the rotor brushes, and the brushes are rocked through 180 deg. to pass from sub- to hyper-synchronous speeds. The connections are shown in fig. 4.

(A) A variable-ratio rotor transformer, capable of transmitting the slip power to or from the commutator brushes, fixes the speed at which the motor runs. A special connection can be used for altering the phase of the transformer voltage in order to raise the power factor.

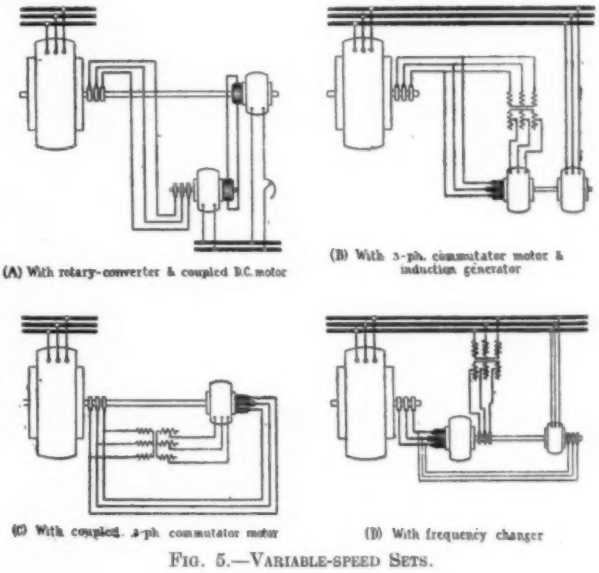

(A) With rotary-converter & coupled D.C. motor
(B) With 3-ph. commutator motor & induction generator
(C) With coupled 3-ph. commutator motor
(D) With frequency changer

FIG. 5.—VARIABLE-SPEED SETS.

(B) It is sometimes possible to obtain the desired rotor pressure by taking tappings off the stator windings.

(C) Where gradual speed control is required, the brushes can be arranged in two equal sets, both being movable and connected to the separate stator phases. Power is supplied through slip-rings to the rotor, while a special regulating winding may be employed as the commutator winding. Every brush position corresponds to a definite pressure and speed.

In the previous types of three-phase shunt motor referred to, and in the three-phase series motors, the transformer e.m.f. becomes zero at synchronism, but in the present machine this e.m.f. remains the same at all speeds, because the frequency of the current in the rotor winding is always that of the supply. In this respect the motor is similar to the single-phase series motor, but in the latter the transformer e.m.f. can be neutralised, whereas in the former it cannot be. Further, the relative motion between the revolving field and the rotor is constant, and this field is carried round by the rotor in such a manner that at synchronism the frequency of the e.m.f. induced in the stator winding is zero. By starting from the neutral position, a starter can be dispensed with, while phase compensation is obtained by shifting the two sets of brushes unequally. The direction of rotation of three-phase shunt motors is changed by reversing two stator leads.

III. Assuming from 15 to 20 h.p. per pole to be the desirable limit for the output of a three-phase commutator motor, such motors cannot well be built for outputs above 300 to 500 h.p. In many cases, however, it is only desired to utilise the slip power of a large induction motor having a limited speed-range. The three-phase commutator motor is well

suited to fulfil these conditions, though it is possibly unsuited for the whole power at supply frequency. Various ways of utilising the slip power are shown in fig. 5. In many cases phase compensation in the main motor is also aimed at. When the auxiliary motor is mechanically coupled to the main motor the drive is suitable for constant output over the whole speed-range; otherwise it is suitable for constant torque. The rotary-converter set (A) has been included on account of its importance. Whenever possible it is desirable to arrange that synchronous speed shall be in the middle of the speed-range, for in this case the auxiliary machines have to be rated for only half the output that would be necessary if synchronous speed were the upper limit of the speed-range.

The paper was illustrated with a number of lantern slides and with the operation of an actual machine.

Discussion in London.

MR. F. CREEDY exhibited two of his machines, and opened the short discussion that followed the reading of the paper by indicating (with the aid of lantern slides, comparing the efficiencies, prices, and weights) the commercial results that had been obtained with the "Creedy" motor. Compared with a standard machine the latter motor was a good deal smaller; the greatest future for the machines described in the paper was open to those which ran at or near the synchronous speed. The reduction of efficiency, as compared with a d.c. motor, was due entirely to the commutator losses. Probably most of the makers of those motors held the same opinions as himself; the machines had drawbacks, but they were not so bad as Dr. Smith had painted them. The control gear for those motors was not so complicated as was commonly assumed, and he thought that much could be done by designing the motors for a certain number of definite speeds, although a gradual change of speed was not obtainable.

MR. LL. B. ATKINSON, by whose name the motors described in the paper are commonly known on the Continent, pointed out that it was not too soon to have the subject ventilated. It should be remembered that in the old days commutators were not what they were now and no one would have more to do with them than they could help; he, therefore, had great difficulty in inducing any manufacturer to interest himself in his (Mr. Atkinson's) ideas. After spending much money on experiments and in maintaining his patents he eventually dropped them altogether. That was not liked in Germany because it prevented a monopoly of the ideas. He firmly believed that the electrification of main railway lines that involved long-distance transmission would have to be on the a.c. h.p. single-phase system, using the motors described in the paper. For ordinary purposes, if electricity supply authorities would charge consumers according to a kVA tariff, the use of the compensated type of motor would be automatically revived, and its use would improve the power factor of existing mains, enabling them to do more work, and so save the enormous capital that was involved in the provision of new generating stations and extensive distribution systems to deal with the growing demand for electricity. He was not in agreement with some of the phraseology used in the paper.

SIR PHILIP DAWSON, M.P., explained that there was a prevalent impression that the single-phase motor was a foreign importation into this country; it was pleasing that that impression had been dispelled once for all by the paper. He had always been adversely criticised for his railway electrification policy, and he was, therefore, grateful for Mr. Atkinson's remarks in that connection. The compensated series motor must prevail on single-phase railways; the original motors used on the Brighton line, fig. 1 F, on which heavy traffic was carried over difficult gradients and curves, were still giving satisfactory service. He could speak with some years' experience which showed that the commutator life was over 10 years, and that the cost of brush wear was negligible. He expected to get even better results when the new motors came into use. After exhibiting single-phase motor characteristic curves and speed-time curves of a six-coach train on the Crystal Palace line, Sir Philip stated that in Switzerland, Sweden, Norway, Germany, and Austria, single-phase electrification had been adopted for all railways; the decisions were come to on grounds of cost, and the whole problem of railway electrification was in every case a financial one. For really heavy work (*i.e.*, lines on which electric locomotives, not motor coaches, were used) it could be shown that in the U.S.A. the amount of d.c. work about equalled the a.c., but on the Continent, the latter predominated. Sir. Philip said he had signed the unanimous report of the Railway Electrification Advisory Committee of the Ministry of Transport purposely to "leave the door open."

PROF. E. WILSON exhibited his original polyphase commutator motor, patented in 1888, and with the aid of lantern slides explained its construction.

MR. F. G. TEAGO had lantern slides shown to illustrate a machine which they had in the Applied Electricity Laboratories at Liverpool University, that had been obtained from the Swedish General Electric Co. by Dr. E. W. Marchant. He explained how, in addition to its brush-shifting mechanism, it had been modified so that its power factor could be varied an dalso described tests that had been made on it.

DR. S. P. SMITH, in reply to the discussion, intimated that much had been left unsaid in the paper, and perhaps it would be as well if it were not mentioned at all. He was of the same opinion as Sir Philip Dawson and Mr. Atkinson with regard to railway electrification, and if he had had anything to do with the Advisory Committee's report mentioned by the former, he would have recommended that the Brighton railway be completely electrified at once, and would have specified that the equipment should be designed and manufactured in England, so that they could be put in the way of competing with foreign makers. Of course the makers of d.c. plant could do the same, but they had probably had enough of d.c. equipment. The knew nothing about polyphase commutator motors which, although invented in this country, had been developed abroad; in the past they had suffered too much from mediocre alien designers.

Discussion at Newcastle-upon-Tyne.

DR. S. P. SMITH submitted his paper at the North-Eastern Centre of the Institution on November 28th, 1921, his remarks being illustrated with a number of lantern slides, and in opening the discussion DR. W. M. THORNTON said several of the authorities mentioned by the lecturer were more or less familiar to them from their text books, but there was no systematic account in the literature of their own, or any similar institution that he was aware of, where the whole subject had been analysed and systematised as had been done in Dr. Smith's address.

MR. F. H. DOWNIE said the lecturer's description had made many difficult matters plain. He had had some experience of a single-phase motor, but he found it sparked very badly and there was, too, a difficulty in starting. They started it as a repulsion motor and it sparked very badly when they changed over.

MR. A. T. ROBERTSON pointed out that a number of patents were taken out, but the machines were never manufactured and consequently they were never, or little, known and anyone developing features of the motors and manufacturing them might quite innocently be infringing someone's rights. That caused manufacturers to be a little chary in what they did. The speaker mentioned a three-phase motor, a description of which appeared in the *Electrician* in 1914, but which Dr. Smith had not mentioned. It was a repulsion motor of seemingly a simple type, but it might have disadvantages.

Messrs. A. B. Maclean, P. F. Allen, G. L. Porter, J. H. Beatty, H. B. Pounder, and J. H. Beard having asked questions, the lecturer replied.

DR. S. P. SMITH thought it was very creditable that Wilson, Atkinson, Hunt, and others had done so much. As to prime inventions he did not think any people had a better record than they had respecting ideas of first importance, but in the subsequent development they were behind. It was not true to say that British firms had not tried to build the machines referred to, but there were difficulties with regard to the patents. Great Britain had not followed the same method as was followed abroad. There they got hold of the inventor, instead of the invention, and the former was a much more satisfactory method. After getting hold of an invention, manufacturers often found difficulty in carrying it into effect; further, inventors often were not good designers. The lecturer also emphasised the fact that often the making of the machines was not a money-making project.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Durability of Lead-covered Cables.

We have read with interest the letters in the ELECTRICAL REVIEW on the above subject, and consider that the undernoted goods should be brought to your readers' notice, as they will no doubt be of the greatest interest and overcome in very many ways the difficulties which have been stated in Mr. Hampson's letter in the ELECTRICAL REVIEW of December 16th, 1921.

In the first place, as regards the question of bonding, a very good system has been brought out recently, known as the "J. C. White" system. This system provides one enclosed box, which can be used as a through box, tee box, 4-way box, or right-angle box, by the simple method of turning the base to the required position. This overcomes one point, and obviates the necessity of a contractor carrying a special box for heavy positions.

With regard to the bonding, the bonding ring supplied consists of one piece only and can be used under a standard

wood block or in the above-mentioned connector boxes. It has also the advantage that it is adaptable for any size of cable up to 7/20 twin lead-covered, the cable being securely bonded by turning up two clips and securing them by the small bolt provided. The result is:—

(1) No opening is left in the box.

(2) No cutting tools are required.

(3) The cable is perfectly bonded inside the box and the wires are joined by using porcelain connectors with screws, giving an ample grip of the wire.

With regard to the question of sheathing of lead-covered cables, your readers should be greatly interested also in the goods supplied by The British Driver-Harris Co., Ltd., Gaythorn Mills, Albion Street, Manchester. This cable is known as "Leadal" cable, and has the great advantage of having a pure lead sheathing rolled on cold, over a 2,500-megohm grade cable, strongly taped. This sheathing is very much thinner than that on ordinary lead-covered wire, and being perfectly rolled over twice the diameter of the cable, meets the requirements of lead-covered wire, both as regards moisture and disintegration. The lead sheathing is covered with a half-round aluminium wire. This wire performs two functions, viz.:—

(1) It keeps the joint of the lead sheathing in perfect position and the joint cannot open when the cable is bent in a required position.

(2) It affords great protection against damage such as bruising and scraping the cable, and the serious question of rats and mice biting through the sheathing.

Besides these advantages, the cable shows an enormous reduction in price over ordinary lead-covered wire, and for any interior job can be recommended as a thoroughly moisture-proof cable.

We have sold quantities of the above goods, and in every case the contractors have given a very favourable opinion, and we have obtained very high tests of completed jobs.

Thomas Land & Son.

Glasgow,
January 7th, 1922.

I have followed with great interest the various letters from readers of the ELECTRICAL REVIEW, on the "Durability of Lead-Covered Cables," and would like very much to give my ideas on the subject. First, speaking as an engineer, I would make mention that it is my idea of an ideal installation, and that I am at the present time superintending the installing of what may be termed a fairly large lay-out. The head of the firm for whom the work is being carried out has expressed his opinion that "it beats everything, for neatness, economy, and durability," thus endorsing my own opinion. Of course, success depends on workmanship, to that we all agree. I have had a fairly wide experience in lead-covered cable work, having had this class of work to contend with in the Navy. Further, I have seen these installations under absolutely the worst conditions imaginable, and when repairs have been necessary they have only amounted to practically 2½ per cent. of the whole installation. In your issue for December 30th, your correspondent, Mr. J. C. White, speaks of a universal connector box; I recently ordered six dozen of the boxes in question, and I may say that they are "The Thing." I have some of them already installed. These have proved entirely to be what they are claimed to be—"Universal." Further, they put what may be termed a businesslike finish to the work, and also add to the general neatness. The installation to which I have referred is being carried out under unique conditions, and if there are any persons interested, I would esteem it a great pleasure to explain, in detail, how the work is being done.

C. E. Whitehead.

Dewsbury,
January 6th, 1922.

[The "J. C. White" connector-box was described in the ELECTRICAL REVIEW of June 18th, 1920. A similar device for c.t.s. cables is dealt with in the present issue.—EDS. ELEC. REV.]

Switching Certificates.

I feel that the letter of "Intermediate," in your issue of the 30th ult., should not be allowed to pass unchallenged in its suggestion that the switching certificates of Messrs. Lundberg are valueless.

Admittedly initiated as an advertising proposition, there is no question that Messrs. Lundberg deserve very great credit for the conception of the idea, and its execution. While I have not seen the more recent competitions, I know from my own personal efforts that their earlier competitions under the supervision of the late Mr. Perren Maycock were an extremely valuable series. It was impossible for anyone to seriously tackle Mr. Maycock's questions without considerable study and labour.

Do not the difficulties of "Intermediate" arise in the general suspicion of diplomas and certificates (whatever their source) so very general among practical men trained in a hard school? The flood of certificates issued by various correspondence schools has helped to add to this suspicion.

Much, therefore, as "Intermediate" may attempt to belittle the value of these examinations, he must at least admit that his experience has been widened by the study they involved, and that he has a better conception of the possibilities of modern switching than he would otherwise have had. To transmute these advantages into £ s. d. is evidently "Intermediate's" difficulty, and that, I would suggest, is hardly the responsibility of Messrs. Lundberg.

J. C. Tree.

January 4th, 1922.

Revenue from Power Supply at Lighting Rates.

I am afraid that the scheme outlined in the article by "Interested" in your issue dated January 6th, would not swell the dividends of many northern supply companies, at any rate. The required conditions do not exist to an extent worth while, but are more like the following:—

Taking an average district of 6,000 consumers, 50 per cent. of these can be counted out altogether. Namely, works and small shopkeepers who are users for business purposes only; 30 per cent. are middle-class consumers who like to have modern conveniences, but have to keep expenditure down to a minimum, leaving about 20 per cent. who may not mind the expense.

Assuming that a number of the last 50 per cent. were persuaded to hire an iron, hot plate, and two small bedroom radiators, to be run from the lighting installation (making sure that the wiring from the distribution board to the bedroom on this circuit would stand the 2,000-watt total of the two radiators), the account for January, February, and March, would reasonably work out at:—

	£	s.	d.
Radiators say one unit per day, seven days per week. = 7 at 7d.		4	1
Iron, say one unit per week, at 7d.			7
Hotplate, say six hours per week, = three at 7d.		1	9
per week	6	5	

For 13 weeks, £3 18s. 5d.

This with an average lighting for this quarter of 1s. 6d. per week = £3 18s. 5d. + 19s. 6d. = £4 17s. 11d., which does not include for the hire of appliances. This as a paying basis would bring the account up to over £5.

The difference in the account would be so striking that the collector's position can be imagined when he interviews "some" ladies of the house.

Collector: "Electricity account, ma'am."

Lady of house: "What! Five pounds!! What's wrong wit' meter?"

Collector: "Nothing lady, the meter's quite in order."

Lady of house: "Nothing, you say! Well look here, young feller, tell your firm to tek the tackle away, an' I'm glad I only hired it."

Sequel (local advertisment): "A number of used domestic appliances for sale. Offers wanted.—Apply, Electrical Engineer."

Let us work for satisfied clients whatever our line.

H. Challis-Sowerby.

Manchester,
January 9th, 1922.

A Message from Mars?

I am no wireless expert, but have pleasure in responding to the S.O.S. call from St. Anne's, though I believe the writer of the letter appearing in your issue of the 6th inst. is very near the correct explanation. Somewhere on his household water installation there is a valve or tap with a worn washer which at times, when water passes, allows the valve jumper to vibrate and chatter; probably the valve in question is in the scullery or quite a long way from the apparent seat of the noise, *i.e.*, the copper cylinder in the bathroom. I could tell quite an amusing story which I heard in London concerning an electric-light installation, an Italian occupier and water taps. All coincide with that period when hostile aircraft considered London as a health resort.

W. E. Rogers.

London,
January 8th, 1922.

Removing Lacquer from Lamp Bulbs.

In response to your correspondent's inquiry, I have pleasure in passing on a splendid recipe given me by an electrician in a large theatre who has "cleaned off" thousands of lamps. Procure any receptacle in which sufficient water can be boiled to hold a lamp and add to the water a piece of caustic soda the size of a walnut. After the caustic has been properly dissolved dip the lamp in, taking care to keep the boiling liquid clear of the cap. The best method is to insert the lamp in a holder with a piece of wood for a handle (this protects the hands), then keep turning the lamp in the boiling liquid for a few minutes; the lacquer should then be easily washed off in cold water. Of course, if the lacquer is burnt (which is not usual with metallic-filament lamps), a slight scraping would be required to remove the burnt parts.

Contractor's Foreman.

January 7th, 1922.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

34,037. "Automatic, &c., telephone exchange systems." H. E. Humphries. December 30th.
34,518. "Electro-magnetic devices." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 22nd.
34,525. "Automatic telephone system." H. Baron (F. Allendorff). December 22nd.
34,538. "Indicating-devices for alternating current electric generators driving induction electric motors." A. B. Field, Metropolitan-Vickers Electrical Co., Ltd., and L. Miller. December 22nd.
34,540. "Prepayment devices for telephone systems." R. Barker, J. E. Collyer, and Siemens Bros. & Co., Ltd. December 22nd.
34,550. "Mercury-vapour pumps for high vacua." Akt. Ges. Brown, Boveri et Cie. December 22nd. (Switzerland, January 8th.)
34,559. "Method for multiple high-frequency telephony and telegraphy on wires." H. Sefton-Jones (Lorenz Akt. Ges.). December 22nd.
34,569. "Electric switches." Bulpitt & Sons, Ltd., and D. McGregor. December 23rd.
34,578. "Electric signalling and recording device." F. Wilde. December 23rd.
34,583. "Sand-gear operator for electric, &c., vehicles and engines." H. Clark. December 23rd.
34,605. "Starter and speed-regulator for electrically-driven fans, motors, &c." C. R. Allen and Veritys, Ltd. December 23rd.
34,622. "Devices for enabling forces due to variations in electrical energies to be used." A. R. Angus. December 23rd.
34,628. "Electric lighting circuits for motor-vehicles, &c." F. A. Johnson and R. W. Maudslay, and Standard Motor Co., Ltd. December 23rd.
34,657. "Wireless direction finding." A. Blondel. December 23rd. (France, December 23rd, 1920.)
34,662. "Ignition magnetos for internal-combustion engines." British Lighting and Ignition Co., Ltd., E. B. Tuppen and E. O. Turner. December 23rd.
34,670. "Switch-operating mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd.
34,672. "Electron discharge apparatus." General Electric Co., Ltd., and B. S. Gossling. December 23rd.
34,675. "Testing insulating wires." J. S. Mollerhoi. December 23rd. (Denmark, January 15th.)
34,677. "Switch." C. A. M. Buckley. December 23rd.
34,686. "Dynamo-electric machinery." Sir C. A. Parsons and J. Rosen. December 23rd.
34,701. "Electric heaters for water, &c." G. E. Loubiere. December 23rd.
34,706. "Terminal for electrical wires or cables." J. W. V. Thurgood. December 24th.
34,718. "Electric switches." H. Lucas and W. C. Turner. December 24th.
34,786. "Dimming device for electric lamps for motor-vehicles, &c." Brolt, Ltd., and W. Holt. December 28th.
34,790. "Electric incandescent lamps." J. F. Lymburn. December 28th.
34,825. "Electrical condensers." W. E. Peek. December 28th.
34,829. "Electric lamp bulb fitting." D. M. Oswald. December 28th.
34,832. "Propeller shaft to generate electric current from dynamos." G. H. Hosie. December 28th.
34,843. "Method of interrupting powerful alternating currents." H. Abraham. December 28th. (France, December 28th, 1920.)
34,848. "Galvanic cell." A. Heil. December 28th. (Germany, December 27th, 1920.)
34,865. "Arrangement for obtaining electric energy at low voltage from high-voltage networks." Siemens-Schuckertwerke. December 28th. (Germany, December 30th, 1920.)
34,868. "Electric trolley poles." G. W. Ferguson. December 28th. (Australia, May 18th.)
34,871. "Setting rotating electric meters." O. T. Blathy. December 28th. (Hungary, April 14th, 1920.)
34,872. "Setting rotating electricity meters." O. T. Blathy. December 28th. (Hungary, December 29th, 1920.)
34,892. "Combined temperature and switch-controlled regulator for electric fans, fires, &c." S. L. Holland. December 29th.
34,898. "Electrical timing device." J. R. Bell. December 29th.
34,904. "Controllers for electric motors, &c." H. Brooke, Electric Control, Ltd., O. Ellefsen, and A. West & Co., Ltd. December 29th.
34,905. "Electrically-controlled scoring apparatus, &c." G. H. Wallace. December 29th.
34,909. "Electro-atmospheric multiple-unit control system for electric railways." F. L. Gill-Knight. December 29th.
34,934. "Windings for alternating-current dynamo-electric machines." F. Creedy. December 29th.
34,937. "Machines for washing dishes, &c." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.) December 29th.
34,940. "Electric accumulators." L. A. Didier. December 29th.
34,944. "Circuit breakers." British Thomson-Houston Co., Ltd. (General Electric Co.). December 29th.
34,947. "Electric driving mechanism for sound-recording or reproducing machines." P. A. Becker. December 29th.
34,959. "Control switches for electrically-propelled vehicles." P. V. Powell and P. F. Smith. December 29th.
34,982. "Electrode-holder for electric arc generators for production of high-frequency electric waves." H. Sefton-Jones (Lorenz Akt. Ges.). December 29th.
34,986. "Telephone transmitters, &c." H. J. Palmer. December 29th.
35,000. "Holders for incandescent electric light bulbs." M. Fellows. December 30th.
35,009. "Electric-plug connecting devices." R. W. Blades. December 30th.
35,017. "Safety lamps for mining, &c." G. F. Colledge and D. Gee. December 30th.
35,030. "Renewable tramway metals." A. J. Tuck. December 30th.
35,036. "Electric lift." L. Steyer. December 30th.
35,037. "Automatic, &c., telephone exchange systems." Siemens Bros. and Co., Ltd. December 30th.
35,045. "Overload switches for motors started by starting resistance." F. Krupp Akt. Ges. December 30th. (Germany, January 3rd.)
35,054. "Electrical apparatus for starting internal-combustion engines." J. W. T. Caddett. December 30th.
35,056. "Directional aerials for wireless receiving stations." E. Bellini. December 30th. (France, May 2nd.)
35,057. "Electrical calling device." Soc. Francaise Electrique. December 30th. (France, March 22nd.)
35,058. "Wireless telegraph receivers." Soc. Francaise Radio Electrique. December 30th. (France, March 30th.)
35,062. "Colloidal chemical processes for purifying substances." A. G. Bloxam. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.). December 30th.
35,071. "Feed mechanism for strip charts, &c., for tramcars, &c." E. H. H. Gordon. December 30th.
35,078. "Earthing choking coils or voltage transformers for high voltages." E. Pfiffner. December 30th. (Germany, January 5th.)
35,079. "Electric arc-light stage-lighting apparatus." A. Anselmi and A. Sernicoli. December 30th.
35,084. "Key connection for wireless transmission." H. Sefton-Jones. (Lorenz Akt. Ges.). December 30th.
35,086. "Reversing switch for planing, &c., machines." Newton Bros. (Derby), Ltd., and F. Newton. December 30th.
35,087. "Irradiation lamps for medical purposes." Quarzlampen Ges. December 30th. (Germany, December 30th, 1920.)
35,088. "Electrical transmission of messages along conductors." Dr. E. F. Huth Ges. & C. Schwarz. December 30th. (Germany, December 30th, 1920.)
35,089. "System of pole-changing for polyphase induction motors." O. T. Blathy. December 30th. (Hungary, June 8th, 1920.)
35,098. "System of pole-changing for polyphase induction motors." O. T. Blathy. December 31st. (Hungary, April 9th.)
35,101. "Alternating-current motor groups." Forges et Ateliers de Constructions Electriques de Jeumont. December 31st. (France, January 26th.)
35,106. "Self-cleaning magnetic feeders." L. Barradell. December 31st.
35,121. "Signal-transmitting device for wireless, flashlight, and hand-line telegraphy." E. J. Quinn. December 31st.
35,128. "Electric treatment of liquids." H. J. Monson. December 31st.
35,156. "Mercury-vapour apparatus." Quarzlampen Ges. December 31st. (Germany, December 31st, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

15,348. "Mercury and other vapour electric lamps." Silica Syndicate, Ltd., and F. Reynolds. June 7th, 1920. (Cognate applications, 5,246/21.) (172,666.)
15,468. "Multiphase dynamo-electric machines." Siemens-Schuckert Ges. December 14th, 1917. (144,660.)
15,678. "Electrical pyrometers of the thermo-couple type and electrical measuring instruments used in conjunction therewith." R. F. Hamilton and Co., Ltd., F. S. J. Pile, and G. E. M. Stone. June 10th, 1920. (Cognate application, 4249/21.) (172,671.)
18,444. "Systems of electro-mechanical starting and operating from a distance by multiple currents." R. Mautsch. April 10th, 1914. (146,421.)
18,663. "Thermionic valves for wireless telegraphy and other purposes." Radio Corporation of America. February 1st, 1916. (146,539.)
20,466. "Accumulators." G. Fromont. July 10th, 1920. (Patent of addition not granted.) (172,679.)
21,852. "Telephone call registers." H. B. Merton. October 25th, 1920. (172,680.)
22,980. "Electrodes for electrolytic batteries." A. E. Alexander (Stuart Electrolytic Cells, Inc.). August 4th, 1920. (172,681.)
25,243. "Electric lamps for kinematograph apparatus." G. A. Knapton and New Union Electric Co., Ltd. September 1st, 1920. (172,694.)
25,719. "Ventilation of dynamo-electric machines." A. B. Field & Metropolitan-Vickers Electrical Co., Ltd. September 7th, 1920. (172,703.)
26,036. "Electro-magnetic apparatus specially suitable for use as a relay, switch, or like device." R. E. H. Carpenter, F. G. Creed, and Creed & Co., Ltd. September 10th, 1920. (172,717.)
26,044. "Contacts for electrical switches." W. J. Line and J. H. Tucker and Co., Ltd. September 10th, 1920. (172,718.)
26,154. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. September 11th, 1920. (172,722.)
26,257. "Electric induction motors." British Thomson-Houston Co., Ltd. (General Electric Co.). September 13th, 1920. (172,727.)
26,267. "Electrode holders." R. W. Heasman. September 13th, 1920. (172,728.)
26,347. "Electric power distribution systems." British Thomson-Houston Co., Ltd., and H. Trenchman. September 14th, 1920. (172,731.)
26,408. "Supporting devices for overhead contact and trolley wires for use on electric railways, tramways, and the like." British Insulated and Helsby Cables, Ltd., and J. W. Astley. September 15th, 1920. (172,735.)
26,894. "Electric switches." O. Lucas and W. C. Turner. September 21st, 1920. (172,751.)
27,189. "Thermionic relays, oscillation producers, and the like." J. Scott-Taggart and Radio Communication Co., Ltd. September 24th, 1920. (172,757.)
27,190. "Thermionic generators, amplifiers, and the like." J. Scott-Taggart and Radio Communication Co., Ltd. September 24th, 1920. (172,758.)
27,242. "Electric heating devices." British Thomson-Houston Co., Ltd. (General Electric Co.). September 24th, 1920. (172,759.)
2,376. "Timing devices or rotary current distributors for ignition apparatus of internal combustion engines." R. S. Bowen and J. R. Rier. September 26th, 1919. (151,638.)
27,653. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). September 29th, 1920. (172,771.)
27,830. "Mine signalling apparatus." Clay Cross Co., Ltd., and J. W. String. October 1st, 1920. (172,779.)
27,876. "Telephone transmitters." R. L. Murray and Telephone Manufacturing Co. (1920), Ltd. December 1st, 1920. (172,780.)
28,069. "Electrical indicator." A. F. Norris and H. L. Holley. October 4th, 1920. (172,785.)
28,110. "Electro magnetically-controlled switching apparatus." R. E. H. Carpenter, F. G. Creed, and Creed & Co., Ltd. October 4th, 1920. (172,787.)
28,461. "Switchgear of the truck or similar type for electric installations." Johnson & Phillips, Ltd., and P. M. Wood. October 7th, 1920. (172,795.)
28,917. "Electrically-heated sad irons." C. W. Winterbotham. October 12th, 1920. (172,805.)
29,416. "Process for the regeneration of electric incandescent lamps." F. Voglhut. October 17th, 1919. (152,652.)
31,059. "Luminous electric discharge lamps." E. Schaeffer. July 14th, 1920. (Addition to 150,957.) (166,506.)
31,344. "Electric switches." G. Lehmann. November 5th, 1920. (172,844.)
31,346. "Terminal banks for selector switches." Western Electric Co., Ltd. (Western Electric Co., Inc.). November 5th, 1920. (172,845.)
32,034. "Secondary battery plates or electrodes." Chloride Electrical Storage Co., Ltd. (E. W. Smith). November 12th, 1920. (172,850.)
33,974. "Tell-tale or indicator for ignition systems of internal-combustion engines and the like." H. G. Kardoc and H. Elliott. December 1st, 1920. (172,859.)
34,967. "Sparking plugs for internal-combustion engines." W. V. Rutter, A. Farrington and G. M. Nicklin. December 11th, 1920. (Addition to 136,109.) (172,865.)
35,006. "Apparatus for measuring the temperature of windings in electrical machines and apparatus." Akt.-Ges. Brown, Boveri et Cie. December 12th, 1919. (155,264.)
35,694. "Twin clip for regulating the height of electric lamps attached to flexible electric wire." E. Beckton. December 20th, 1920. (172,868.)

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126. "Telegraphonographs." Telegraphon Ges. January 3rd, 1921. (Addition to 147,555.) (173,872.)
489. "Rontgen-ray apparatus." Reiniger, Gebbert & Schall Akt. Ges. June 23rd, 1915. (156,554.)
676. "Rontgen-ray apparatus." Reiniger, Gebbert & Schall Akt. Ges. January 12th, 1921. (Addition to 156,554.) (156,678.)
771. "Electric fuses." Metropolitan-Vickers Electrical Co., Ltd. January 12th, 1920. (156,721.)
1,303. "Electric gas-filled flow discharge lamps." A. Lederer. September 15th, 1913. (157,383.)
4,664. "Wireless signalling in mines." Ges. für Drahtlose Telegraphie. February 9th, 1920. (158,907.)
9,595. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. September 28th, 1920. (Divided application on 27,557/20.) (172,901.)
11,334. "Copying telegraphs." M. H. Petersen. June 17th, 1920. (165,074.)